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Small eastern flying squirrel.

SOME IMPORTANT TIMBER TREES AND WILDLIFE

By WILLIAM R. VAN DERSAL [1]

THE important part played by forests and woodlands in the production of wildlife has been a matter of common knowledge ever since man began to hunt. It fortunately is true also that properly maintained wildlife populations have an important beneficial effect upon the forests and woodlands they inhabit. In particular, the relations between insectivorous birds and mammals and forest pests have been much studied, and it is now known with certainty that while wildlife is unable to cope with sudden and spectacular outbreaks of forest insects, its continued repressive action upon them is of fundamental value in the maintenance of healthy stands. It is increasingly recognized, too, that forest wildlife can provide additional and subsidiary annual income—a point of some interest when account is taken of the length of time required for timber to reach marketable size. In other words, from an economic as well as biological standpoint, wildlife is an asset to the forest which in turn provides it with a place to live.

It has been shown that the treatment of existing wooded areas for purposes of soil and water conservation enhances the value of forest habitats for wildlife. In addition, recent studies indicate that there is no operation that is silviculturally sound which cannot influence wildlife to advantage if properly used. It is now clear, in fact, that forest values whether for timber production, wildlife, or soil and water conservation, fluctuate as one and that the total worth of a forest depends on the maximum expression of its several values.

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In the proper management of existing forest, no less than in the development of new plantings, the wildlife aspect has received increasing consideration in the past 10 years. Relations between various systems of silviculture and wildlife populations are being studied. Much already has been learned of the wildlife values of woodland margins, of variety in stand composition, den trees, variety and luxuriance of understory trees and shrubs, and the like. Relatively little has been written, however, of the importance of the timber trees themselves, especially in relation to the wildlife food supply which in the final analysis must limit the kind and quantity of wildlife that can exist in any given habitat.

In accumulating records on the use of plants by wildlife as mentioned in the literature or supplied by the Biological Survey, it was soon learned that many forest trees may constitute an ofttimes important source of food supply for many wild species. The records, in fact, seemed of sufficient interest to deserve brief review, and are considered here in relation to trees of outstanding importance in timber production and soil conservation. Incidentally, no attempt is made to evaluate the damage done by excessive numbers of wildlife resulting from human misuse of one type or another. It is of course well known that unbalanced wildlife populations can cause considerable local damage, but it also seems reasonably clear that where proper biological and silvicultural practices are in effect such damage may be substantially reduced.

Pines

The pines comprise the largest genus of the conifers, and are probably the most important group of timber trees in the world. From the point of view of lumber production in this country pines rank first, supplying as they do nearly one-half the total wood cut in the United States each year. They have been very successfully used in soil conservation plantings, outranking in numbers planted any other genus of woody plants. The distribution of the group is widespread in the United States, one or more species being found native in every State in the Union except Kansas, and in many States a number of species are present. California, for instance, has 17.

With such a far-flung range and constituting such great forests, pines should stand high in records of utilization by wildlife. Such is actually the case, as more kinds of wildlife feed on pines than on any other genus of trees except the oaks. At present a total of 134 birds and mammals are recorded as having eaten some part or other of a pine. For many of these animals the pines furnish an important supply of food, and often are highly relished or preferred to many other types of food. The seeds of the pines are more commonly eaten than other parts of the trees, and are a staple for many birds and mammals. Staminate and young pistillate cones probably are next in importance, followed by buds, needles, and bark. Every part of a pine above ground may serve as food for one or more kinds of animals.

Pine seeds are particularly palatable to crossbills, finches, grosbeaks, jays, nutcrackers, siskins, quail, and woodpeckers. Among game birds, five kinds of quail, nine kinds of grouse, the ring-necked pheasant, band-tailed pigeon, mourning dove, greater prairie chicken, ptarmigan, and wild turkeys have been known to utilize pines in their diets.

For mammals, the pines apparently are of greatest importance to certain mice, squirrels, chipmunks, deer, and porcupine. There is little doubt that all squirrels and chipmunks will use pine seeds where they are available, although present records include no more than 16 kinds of squirrels and 11 kinds of chipmunks. It is interesting to find that records include utilization by bears, foxes, snowshoe hares, cottontail rabbits, mountain sheep, elk, opossums, and even coyotes, although there is reasonable doubt in some instances as to whether the use was more than casual or accidental. Present records show the piñon pine to have been utilized by 21 kinds of wildlife; northern white pine ranks second with 17; ponderosa pine is third with 14, and lodgepole pine fourth with 13. Very generally speaking, the widest ranging species of pine appear among those known to have been utilized by 10 or more animals. Pines of more limited distribution are utilized by less than 10 animals, with the exception of piñon pine.

Douglas Fir

Second in importance from the standpoint of timber production, and ranking high for soil conservation planting within its range, is the Douglas fir. This tree, which has been variously treated as from 1 to 12 separate species, occurs on the 2 great western mountain ranges—the Cascade-Sierra Nevadas and the Rocky Mountains—accompanying them from north to south and from sea level to rather considerable elevations, especially in the southern mountains. In its Pacific Coast form, this tree is second in height only to the giant sequoias of California; in the Rockies it seldom grows taller than 130 feet.

Records at present available show the Douglas fir to have been used by 18 kinds of mammals and 9 birds. These animals include white-tailed and black-tailed

deer, bighorn, chickarees, squirrels, chipmunks, elk, porcupine, grouse, and ducks. The tree ranks among the first 25 woody plants of the United States in point of wildlife utilization for food. Present records undoubtedly are incomplete, not to say fragmentary, but as they accumulate, the Douglas fir will in all likelihood rank much higher than it now does.

Oaks

Third in importance in point of lumber production are the oaks, but for wildlife they rank higher than any other genus of trees. There are about 85 species of oaks native to the United States. In the West they are more commonly shrubs or small trees but in the East they are important dominant trees in most forests. Except for the northern Rocky Mountain region where they are almost entirely absent, oaks are found in all States, and for the eastern half of the country perhaps no other genus of broadleaf trees is as well represented in number of species and individuals as are the oaks.

During the past 2 years 39 tons of acorns have been collected by the Soil Conservation Service for use in erosion-control work. Of all species used, the northern red oak (*Q. borealis* and its variety *maxima*) ranks highest in point of numbers of plants used. Because of the ease of "spot planting" the acorns, rather than employing plants, use of oaks has risen rapidly within the past few years so that they now rank about third among trees used for soil-conservation planting.

Some part or another of an oak is eaten by 186 kinds of birds and mammals, as at present recorded in the literature or Biological Survey files. The acorns are eaten by a very considerable number of birds and mammals. Sprouted acorns are taken by bobwhite, squirrels, deer, and mice; oak leaves are an important browse of deer; the inner bark, or cambium, is used by sapsuckers; the bark is eaten by porcupine, the twigs by beaver, the staminate flower spikes by prairie chickens, and even the nutritious galls are utilized by several kinds of birds. The geographic distribution of certain animals such as raccoon, band-tailed pigeon, and California woodpecker has been stated to coincide with or be dependent upon the range of oaks.

There would be no point in listing all the animals that feed on oaks. A great many upland game birds depend upon acorns in fall and winter. Numerous waterfowl use them; white-tailed and black-tailed deer appear to utilize acorns wherever they are found; and the order Rodentia including squirrels, chipmunks, chickarees, muskrats, ground squirrels, mice, and rats, accounts for 72 percent of the present mammal records.

Tiny birds—wrens, titmice, chickadees, nuthatches—use them; so do peccaries and thick-billed parrots of the Southwest. Bears very often eat quantities of acorns just before they hibernate; and rabbits, foxes, ring-tailed cats, elk, skunks, beaver, and even opossums are on record as using oaks for food.

Aside from their impressive record of utilization, oak acorns are known to be a "staple" food, that is, like corn, they can sustain life for long periods in the near absence of other foods. Any staple food is believed to be of greater relative importance to wildlife than are foods of the succulent or "salad" type furnished by berries and other fruits even though these may be conspicuously relished. Oak leaves have been shown to be palatable and nutritious to livestock, provided they are not eaten to the total exclusion of other foods, and from studies available on wildlife feeding in captivity as well as the wild state it appears that wild as well as tame herbivores may profit from feed as good as oak leaves are shown by analyses to be.

Unfortunately the oak records are not as specific as could be wished. Some of the species are difficult to identify, and so most records merely show "acorns" or "oak browse" to have been eaten. In fact, 40 percent of the oaks have no records attached to them at all, as species. In other words, while there is a substantial quantity of data available to show the oaks as a genus to be of outstanding importance to wildlife, it is much less specific than is necessary to determine whether some of the 85 native oaks are of greater importance than others.

Hemlocks

The genus *Tsuga*, containing two eastern and two western species, ranks fourth in terms of lumber production. The trees are not as abundant throughout their range as are oaks or pines, although geographically they are widely distributed. The western hemlock (*T. heterophylla*) is the most important of the four from the timber production standpoint; the eastern hemlock (*T. canadensis*) is one of the principal sources of tannin. In spite of their silvicultural values, however, none of the species has been used very extensively for soil-conservation planting because their site requirements are higher than are usually found on eroded land.

Twenty different kinds of birds and the same number of mammals—a total of 40—are known to use hemlock seeds, leaves, buds, or bark in their diets. Among birds the list includes chickadees, crossbills, crows, several ducks, goldfinches, three kinds of grouse, nuthatches, siskins, and woodpeckers. Mammals are rep-

resented by bears, chickarees, chipmunks, many kinds of deer, porcupines, rabbits, a good many squirrels, and elk.

Red Gum

Enough lumber is produced from red or sweet gum to place it fifth in importance as a timber tree; the species is second only to the oaks among commercial hardwoods. This tree ranges throughout the southeastern United States, and is found on a great variety of sites from bottomland to old fields. It is able to grow on severely eroded soil and probably should be used more widely in conservation plantings than it has been in the past. In the region where it grows, however, it must compete commercially with the pines, a fact which may account in part for its relatively restricted use.

Twenty-seven different kinds of animals feed on red gum. These include finches, grosbeaks, crossbills, siskins, ducks, chipmunks, squirrels, and many others. It is ranked as a relatively important food for the bobwhite, and in season may form a large percentage of the diet of these birds, especially where the tree is abundant. Seeds are the portions most commonly eaten.

Maples

Maples rank sixth in lumber production, being third among commercial hardwoods. Sugar maple, black maple, red maple, and silver maple of the eastern United States, and bigleaf maple of the Pacific Coast, are the important wood-producing trees of the genus. Sugar maple has been used to some extent in the Northeast for soil-conservation work, and the box-elder, classed by some among maples and by others as distinct, is widely used for wind-erosion-control planting because of its resistance to drought.

Total present wildlife records for the genus amount to 47 kinds of animals. Finches, grosbeaks, pheasants, grouse, beaver, chipmunks, deer, elk, squirrels, and moose utilize the plants most commonly. The shrubby-mountain and striped maples, as well as red maple, are of considerable importance as browse for white-tailed deer and moose; in the West, the vine and dwarf maples, as well as the bigleaf maple, are similarly browsed by mule deer and elk.

Redwood, Cypress, and Spruce

Redwood and cypress have been used only in negligible quantities in soil conservation plantings, but they rank seventh and eighth respectively for lumber production. Although these trees are among the largest in the country, their available wildlife record is

Excellent stand of mixed hardwoods—oak, poplar, hickory. Most of the trees are straight. Diameters are from 12 to 30 inches. Height sometimes exceeds 100 feet. Good underbrush cover, with heavy leaf mold.

relatively small, only 2 species being recorded as utilizing the sequoias and 13 as eating seeds and other parts of the cypresses. The sequoias are restricted in range; the cypresses are restricted largely to one site. These facts help to account for the poor wildlife record as well as their restricted use in soil conservation planting.

The spruces have a more impressive wildlife record than the last two groups of trees; a total of 62 different kinds of birds and mammals are known to utilize them. Spruce ranks ninth in lumber production, the white, Engelmann, black, blue, red, and Sitka spruces being the most important. For soil conservation work spruce used to rank third but has now dropped to seventh place and may possibly go further down the list. The birds finding spruce seeds or buds particularly attractive include crossbills, grosbeaks, woodpeckers, and a great many kinds of grouse as well as waterfowl. Among mammals chipmunks, chickarees,

squirrels, deer, and porcupine apparently find acceptable the food provided by spruces.

Tuliptree and Tupelo

The tuliptree or yellow poplar of the eastern United States ranks eleventh in lumber production and tenth in soil conservation planting. Even though associated with climax trees in hardwood forests, this tree often pioneers on severely eroded areas and barren hillsides. The present wildlife record for this species is a relatively poor one, as only seven kinds of birds and mammals utilize the plant. Most of the records appear to be casual, but purple finches, evening grosbeaks, and squirrels seem to use the seeds as a regular part of their diets. White-tailed deer browse it but apparently not to any great extent.

Tupelo, including four species of *Nyssa*, ranks tenth in lumber production. One species, the black or sour gum (*N. sylvatica*), has a very good wildlife record and is also the most important wood-producing member of the genus. It is not at present used for soil-conservation planting but it ranks well up among the first 10 woody plants of the United States in point of numbers of wildlife species feeding upon it. The tree has a very wide range in the eastern half of the country and its blue-black fruits are much used by many kinds of waterfowl, game birds, and song birds, as well as bears, chipmunks, and white-tailed deer.

Chestnut and Beech

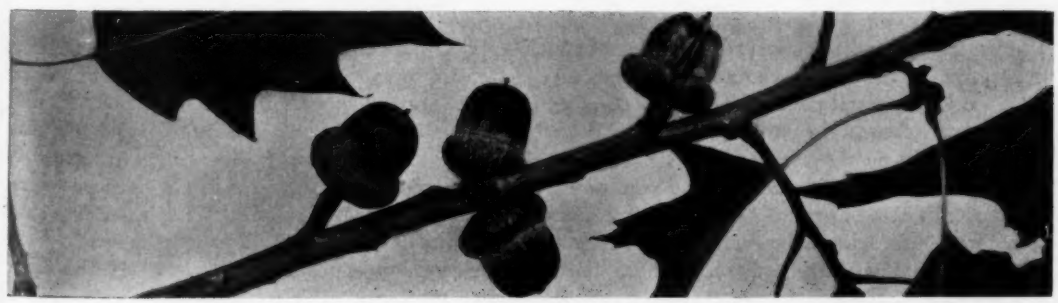
Space does not allow exhaustive treatment of all timber trees, but a few of unusual interest that rank below the first 10 in lumber production deserve mention. The native chestnut, for instance, still ranks eighteenth in lumber production although the ravages of the chestnut blight have reduced the trees to sprouting snags over most of the range. There is no doubt that chestnuts formerly were of great value to wildlife during autumn. The nuts produced so plentifully were an important food for squirrels, chipmunks, turkey, quail, and many other animals. The effect of eliminating this tree from the native flora is not clear; possibly various species of oaks may come to occupy its ecological niche. For obvious reasons it cannot be used in new plantations.

Beech, often considered of little importance silviculturally, nevertheless ranks seventeenth in importance for the production of lumber, surpassing ash, elm, walnut, hickory, and others in this respect. Its wildlife record is an impressive one, placing it among the first dozen native woody plants. The seeds, commonly referred to as "beech mast," are a principal and staple food for many squirrels, chipmunks, woodpeckers, raccoons, foxes, bears, turkey, grouse, and even deer. The fact that it is a dominant tree only in climax forests, and that its site requirements are consequently higher than are offered by eroded land, has made it of relatively little use up to the present in soil conservation plantings.

Ash, Basswood, Sycamore, and Locust

Ash, ranking in nineteenth place for lumber production has a record of use by only 20 kinds of animals. Basswood, in twentieth place, is recorded as used by 21 kinds of animals, and is of particular importance to cottontail rabbit, fox squirrel, and chipmunks. Sycamore in twenty-fifth place has a wildlife utilization record of 16 kinds of animals, although many of these records are casual.

Black locust, although not quoted specifically in recent lumber-production surveys, is interesting because of its extensive use for conservation planting. It has been widely grown in the United States and while it has not proved to be as adaptable as once supposed, it has been successfully grown on a great many sites. It is considered an important food for bobwhite, and records show its use by 13 other kinds of animals.



Quercus borealis.

THE REHABILITATION OF FAMILIES IN MAINTENANCE WORKERS UNITS ON THE PENSACOLA LAND-USE PROJECT

By WILLIAM A. ALLABAND[1]

A GREAT deal has been written on the accomplishments of development programs on land-utilization projects to reestablish productive values of submarginal lands. Not so much is known, however, of what has been done for the people who were living on these large areas of cut-over and waste land.

On the Pensacola development project of the land-utilization division, it was realized, during the spring of 1938, that while progress was being made toward rehabilitating the land, the effort to relocate suitably the families who were stranded on the land was heading toward a standstill. Acquisition operations had been started in the spring of 1935 by the Agricultural Adjustment Administration and continued by the Resettlement Administration, for the purchase of 200,000 acres of land in the northern parts of Santa Rosa and Okaloosa Counties in northwest Florida. It was intended that this area be included in a demonstration project.

The family census showed that 134 families were living on the land at that time who would be dislocated by the proposed development program. Each family had to be considered as a separate problem. The families had little in common, except poverty and dependence on the Government for subsistence. While the Farm Security Administration, through its rehabilitation division, offered financial aid to families in the form of grants and loans, to induce them to move to more suitable locations outside the project area, very few persons took advantage of the offer. This was due to the difficulty of finding new locations where assurance of permanent betterment could be given. Many families showed very little interest in moving at all. When offered the opportunity to earn the $21-a-month security wage given by the Works Progress Administration to laborers employed in the project's development program, they were quick to forget the hardships and privation previously suffered.

This general attitude was reflected in the statement of a client: "I know that I could probably find some other place where I would be much better off than I am here, because I am slowly starving to death, but I was born and raised here. I know every tree and pig path in this section and I can't bring myself to the point of leaving it. This is home."

Since the area was home to so many people, and a good home before its natural resources were depleted, the project staff began to consider a new approach to the problem: with the reestablishment of the forest, it might be possible to work out some plan for the permanent rehabilitation of these families on the land that they called home. If it could be done the final result would constitute a demonstration of land and human rehabilitation, on the same area, that would be worth duplicating on millions of acres of similar land.

It was decided that an inventory be taken of existing physical resources to determine the tangible and intangible values that caused the people to put love of home above fear of starvation. The investigation showed that in the purchase area there were many parcels of land, some of them formerly in primitive cultivation, which could be utilized for farming under more favorable economic conditions. A soils survey of a number of the parcels showed that with proper management the land could be made reasonably productive.

Furthermore, there was on the property a large number of partly completed houses—ghosts of a land-colonizing plan that had failed dismally. A French Canadian promoter in 1926 had purchased, from the lumber company which had cut the timber, some 4,000 acres of the worst farm land on the development area. By means of a glowing prospectus, amply illustrated with pictures from other areas some hundreds of miles away, he had succeeded in selling 30-acre farms to about a hundred persons of French-Canadian extraction employed at the time in factories in New England. Those people, with savings accumulated over a long period, moved in and, ignorant of local conditions, failed to recognize as impossible the land they had purchased sight-unseen. With the natural energy of their race they applied themselves to clearing the land and erecting homes and buildings on it. Before most of their homes were completed under the stress of the high construction costs pravailing in 1929, they were faced with the necessity of earning a living from the land they had prepared for their homes. It is unneces-

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sary to go into the details of the dismal failure they suffered in return for their efforts. They readily accepted the best price the Government could offer for their homes, although it was only a fractional part of their expenditures. They returned to the homes of relatives to begin anew the struggle to make a living.

In the meantime, piles of lumber salvaged from abandoned farmsteads and lumber company structures had grown in size, with no definite plan for utilization. The partial failure of a wildlife food-patch experiment had left a large amount of fencing for which no effective use had been designated.

With all those potential assets, together with the anticipated need for a dependable labor supply for operation of the project, it was not difficult to decide that the most effective solution of the problem could be realized by the establishment of strategically located groups of maintenance-workers subsistence units. Administrative headquarters and a pine tree nursery already had been established at Munson, Fla., in the center of the area. The soils survey had shown that approximately 300 acres surrounding the site of an old sawmill were suitable for cultivation and could be cleared with a reasonable expenditure of funds. The location already had a church, a consolidated high school and a community store.

A group of farms was laid out, ranging in size from 18 to 30 acres, and each unit was completely enclosed by fence with sufficient cross fences to permit cultivation of crops and the rotation of livestock among the fields. With provision thus made for livestock production, a supply of meat was assured for family use, to supplement a small income from cash crops. A garden plot, varying in size from one-half to 1 acre, was provided on each farm unit. A similar area was arranged for double chicken runs, and an area was reserved for a house lot large enough to permit landscaping in front of the house and production of fruit in the rear. Plans were then prepared for remodeling the partially completed houses into comfortable small homes of from 4 to 6 rooms, having screened front and back porches. A deep well with a hand force pump was driven immediately behind the house site—project labor and salvaged pumps made this addition possible. A small barn with space for a mule, a cow and feedstuffs, and a standard-design chicken house large enough to accommodate from 60 to 100 chickens, were built from salvaged lumber. A sanitary pit-type toilet was established at a convenient distance from the house.

The houses to be utilized at subsistence units were moved 8 to 10 miles from their original locations—nor did they present the difficulty in moving that would ordinarily be expected. They were thoroughly braced inside and jacked up, and long timbers were placed under them. A heavy-duty trailer, regularly used for transporting the project's heavy equipment, was placed under a house and thus it could be moved rather quickly to its new site. A small crew of men often prepared and moved a house in a single day. Outside brick foundation piers had been laid at the new location before the house was moved so that the moving crew could set the house on blocks over its new location; thus, as quickly as the middle piers were laid, the house could be lowered into place.

The interiors of all houses had to be finished, front and back porches added, roofs and windows repaired, new chimneys erected, windows and porches screened, and the interior and exterior painted. The final result was a very comfortable house for the family, with privacy and sanitary conditions unknown to those who had been accustomed to living in bare two- and three-room board shacks.

After all the stumps had been removed from the fields of subsistence units, the land was plowed with a heavy fireline plow that turned vegetative growth under to a depth of 10 inches. This operation was followed by cross plowing with the same plow; and then the entire area was disked with a light gang-disk harrow to pulverize the soil for the planting of winter legumes, the green-manure crop, and oats for winter pasturage. Separate fields were seeded to Austrian winter peas and hairy vetch. Oats were planted in fields where it would not be necessary to plant early field crops. The purpose of thus preparing the soil was twofold: First, that the occupant could start his farming operations under the most favorable conditions possible, and, second, that he might be encouraged in the use of winter legumes.

By the fall of 1938, 15 of these units were ready for occupancy. Since the units had been established for project workers, it was decided that these farms be set up on a rental basis. The purpose of establishing the subsistence units was to provide quarters and limited farm facilities for permanent project employees. Under the future plan of management, these workers would be provided with part-time employment in carrying on the normal maintenance operation of the project or assisting in the harvesting of its natural resources. Thus the worker would have the balance of his time to devote to his farm operation. The proportionate amount of time to be devoted to project employment and personal farm operations would vary from month to month, depending on conditions and normal seasonal requirements. It was estimated that

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the minimum annual project employment would consume approximately one-half the normal work time of these employees.

Reimbursement to the worker and the administering agency of the project, for labor and rent respectively, was to be entirely by cash settlements. Workers were to receive the same prevailing wages paid by the administering agency to other labor for like services.

The annual rental, as decided upon, to be paid by the worker to the administering agency, was not to amortize the cost of the original investment, but to obtain sufficient revenue to maintain the property in good repair and provide the necessary replacements of structures over a period of years. It might be well to state at this point that the average cost of a completed unit was approximately $2,500. Local property values indicate that comparable facilities in the surrounding section would have a market value of at least $4,000. The annual rental, figured on a depreciation basis, varied with the size of the house and the amount and quality of the land connected with the unit; it averaged approximately $3 per acre. This charge compared favorably with the average rental charge of that section of country for other farm land not incorporating the advantages offered workers on subsistence units.

It is almost unnecessary to state that the management of the project was flooded with applications from every direction before the units were ready for occupancy. Many could not be given consideration because the applicants were not residents of the project area. As was stated before, one of the main purposes in constructing these units was to solve a rehabilitation problem among families living in locations unsuited to agricultural purposes. The project manager discussed the applications with his work supervisors and with reputable citizens of the section, looking forward to the selection of the best families available from the applicants. Consideration was given to size of the family, the attitude the applicant had shown in his work on the project, conditions under which he was living at the time, his general reputation for industry and integrity over a period of years, and other general observations made by the management of the applicant and his family during the years of development work on the project.

There was very little criticism of the final selections made, and there were few disgruntled applicants. It was explained that the project hoped to build additional units over a period of years, and that it was quite possible that the less fortunate applicants would be able to secure places later. Each successful applicant was given a use agreement to sign, permitting his occupancy of the unit for 1 year, with renewal privileges to be determined mutually by his desire for another year's lease and the Government's privilege of refusal if he failed to make full use of the advantages offered him.

As is generally true of the inhabitants of cutover waste lands, it was found that all our applicants were experienced in lumbering operations and public work, but had had very little farming experience beyond that gained in the cultivation of a small patch adjacent to the house in which they lived. Their hogs and cattle had been allowed to rove in the open. Most of the families had no equipment for farming, or even sufficient household furniture to make full use of the facilities offered.

The local supervisor of the rural rehabilitation division of the Farm Security Administration had evidenced a great interest in our experiment and upon request he secured the approval of his superiors to cooperate in establishing the clients on a subsistence farming basis. He executed a 5-year loan agreement with each applicant whereby his agency lent the money for the purchase of work stock, a limited amount of farm equipment, seed, fertilizer, feed, livestock, and canning equipment. The loans varied from $85 to $300 per family according to the need as determined by the supervisor and his assistants. Loans were limited to the bare necessities required by the family to commence operations on the farm.

The applicant was expected to enter into community arrangements for cooperative use of farm equipment, and to secure other necessities from his supplementary earnings on the project. At the end of the crop year he was expected to repay a minimum of 20 percent of his original loan, and it was hoped that he would have sufficient feed and seed to finance his next crop without additional loans. The entire amount of the loan was deposited to the credit of the client with the stipulation that checks drawn for purchases be countersigned by the Farm Security Administration supervisor in accordance with a farming plan mutually agreed upon.

The farm plan anticipated the planting of a large garden for fresh vegetables and the canning of at least 400 quarts of fruits and vegetables for consumption during the winter months. It was proposed that sufficient corn and peanuts be grown to carry 1 mule, from 20 to 30 hogs, and a flock of chickens. A small acreage was to be devoted to the production of potatoes and of sugarcane for sirup. Five to 10 acres were to be utilized for the growing of peanuts for sale. Each farm plan stipulated complete utilization of the entire

area of cultivatable land in each unit. A community pasture, with improved grasses and conveniently located to all units, was made available for pasturing milk cows. A large woodland pasture comprising 700 acres provided the client with range near his unit for pasturing other stock. It was believed that the plan would permit each family to grow its essential food and meat and have a surplus of potatoes, sirup, vegetables, eggs, poultry, and pork for sale. The acreage was not so great as to prevent part-time employment on the project for supplementary income to purchase necessities.

Since it was to the advantage of the clients to purchase supplies and equipment as cheaply as possible, they soon formed a small mutual cooperative association, without charter, for the purpose of collective bargaining and to foster social gatherings for discussion of matters of interest to them. The initial membership consisted of the 15 families in the workers' maintenance units and the 5 families in lookout towermen's units, each of which had a subsistence farm connected with it. Membership was thrown open, however, to all families in the immediate section who desired to join, without the restriction of occupying Government property. Many independent farming families joined the group, which became known as the "Blackwater Cooperative Association." The president and secretary of the group received attractive bids from numerous vendors and each individual consummated his purchases at the prices quoted the group.

The purchase of fertilizer is a good example of the savings made by the arrangement: The prevailing price for commercial fertilizer in small quantities was $16 to $17 per ton, but group members were able to purchase it for a fraction over $11 a ton delivered to their barns. The project game breeder, in charge of the quail hatchery, had had considerable experience with poultry, and he encouraged all the clients to purchase 50 or more thoroughbred day-old Leghorn chicks to start a poultry flock. The chickens and the necessary feed for them was not a part of the loan made by the Farm Security Administration, but all members entered into the care of the chickens with great interest. In all probability most of the clients never before owned any good grade chickens, and most of them did not have any chickens at all when they moved into the units.

Discourse on experience of this nature could be continued, but it is felt that a brief summary of the results of the method of rehabilitation after its first 8 months of operation is perhaps more important. The families all appear happy in their new homes and evidence a desire to renew permits for the following year. The management is pleased with progress made to date and does not now anticipate refusal to renew the permits. The management of the project feels that the economic position of the clients has improved and that prospects are better than those of any of the families which were relocated outside the project area. The church in Munson, which has had meetings only at rare intervals during recent years, is functioning again. The consolidated school, which many people feared would close with the acquisition of land by the Government, is expected to continue operation.

Doubt that the clients would be able to take care of the farms and still work on the project has been dissipated by the energy evidenced by the occupants of the units during the period of heaviest farming operation in the spring. The writer has often observed men working in the fields at 5 o'clock in the morning who reported for work on the project at 7.30. After the day's work on the project, the men often worked in their fields again until dark. The people have shown a tendency beyond the average to remain at home and work on their units. Although this crop season has been most adverse, due to abnormal rainfall, crops are better than the average for the locality and, in all probability, the clients' payments on loans to the Farm Security Administration will be satisfactory. When development operations on the project were suspended for 2 months, the occupants of the units fared much better than did persons who had not been fortunate enough to receive that type of rehabilitation. One of the requirements of an occupant of a workers' unit is that he aid in suppressing forest fires on the area whenever requested, without compensation. This has proved a decided advantage to the Government and has given the worker a feeling that he is protecting something in which he has a very definite interest.

It is the opinion of the writer, therefore, that this method of rehabilitation could be expanded considerably on this project without exhausting its possibilities, and that the welfare of the families and the project will become increasingly better each year as the forest becomes reestablished and as the families provide themselves with livestock for additional income.

The true measure of success of a demonstration in multiple land use lies in its ability to incorporate the social and economic rehabilitation of the area's inhabitants into a mode of living that provides increasing opportunities for betterment within that immediate locality.

CONSERVATION PRACTICES IN PRIMITIVE AGRICULTURE OF THE SOUTHWEST

By GUY R. STEWART [1]

THE Southwest, as referred to in this article, includes the southern portions of Utah and Colorado, together with the States of Arizona and New Mexico and adjacent areas of northern Chihuahua. This country, which embraces a land with a wide diversity of topography and variations in local conditions, has also certain similarities. Throughout much of the region high summer temperatures may prevail, though on the higher plateaus, as at Mesa Verde and the Taos Valley, the elevation does much to temper the heat. Over the entire area, however, rainfall is often either deficient or highly variable so that water is the greatest limiting factor in successful crop growth. The accompanying sketch map, figure I, is divided into five main areas which, though probably not all occupied at the same time, at various periods supported portions of the highly developed primitive culture of the Pueblo people. All the tribes living in this land of desert and mesa had a unifying interest: they were sedentary farmers using a specialized maize agriculture as the basis of their successful racial existence.

Throughout most of this country a series of stages can be traced in the development of house building and agricultural skill. These stages often are divided into several steps;[2] the people of the early basket maker culture, for example, seem to have been among the first to occupy the land, and it is known that they lived in small, separate family dwellings. The basket makers were followed by the first of the Pueblo dwellers who not only built a better type of house than did their predecessors but also advanced beyond them agriculturally by introducing cotton and domesticating the wild turkey. In the second stage of Pueblo development the people gathered in small houses arranged in little villages. Next came the period of maximum Pueblo development, the so-called classic period, when the large communal dwellings reached their greatest size. Possibly this very concentration of the people in greater centers brought with it the ills which we class as those of civilization, such as increase in communicable disease resulting from close contact and lack of sanitary knowledge, and so began the breakdown of the system of big pueblos. The fourth period, that of redistribution and partial abandonment of the large villages, was well under way when the Spaniards entered the country.

The chronology of these periods has been determined through a study of pottery types and tree-ring analysis.[3] By these processes it has been shown that the Pre-Pueblo period was prior to about A. D. 1000, while the height of Pueblo development was from about A. D. 1200 to 1400. Although the entire five sections shown in figure I are sometimes spoken of as constituting the area of Pueblo culture, the section

[1] Assistant to the chief of research, Soil Conservation Service, Washington, D. C.

[2] Early Pueblo Ruins in the Piedra District, Southwestern Colorado, by F. H. H. Roberts, Jr. Bulletin 96 of the Bureau of American Ethnology. 1930.

[3] The Secret of the Southwest Solved by Talkative Tree Rings, by A. E. Douglass National Geographic Magazine, vol. 56, p. 736. 1929.

Boulder dams diverting water into rectangular plots, mesa above Peck's Wash.

comprising the Gila and Salt River Valleys is distinguished by its having had the greatest known development of a system of primitive irrigation, as shown by Turney's [4] studies. It is often spoken of as the country of the Hohokam who successfully practiced regular irrigation for a period of at least 200 years, from A. D. 1200 to 1400.

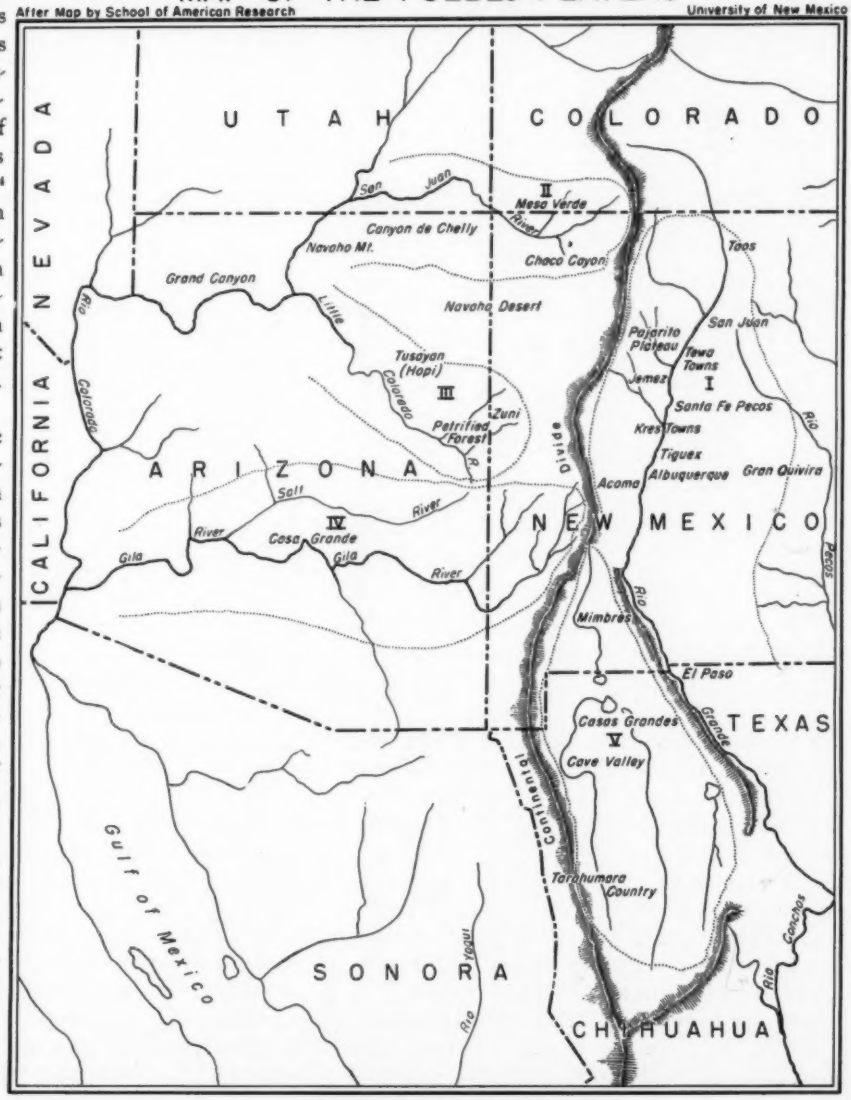
Several authors have devoted some attention to the modern agricultural methods used among southwestern Indian cultivators. The writer's interest became aroused a few years ago in trying to discover whether any consistent record could be obtained of the use of conservation measures in the primitive settlements of this region. A considerable survey of the literature has uncovered studies, by Bryan and others, of the early use of water spreading. Hewett [5] has referred in several places to instances of terracing. Sauer and Brand [6] have studied the prehistoric sites of Sonora with special reference to the occurrence of "trincheras" or entrenched hillside terraces, which they now have concluded are clearly nonagricultural. Brand,[7] however, has made other observations on an agricultural type of terrace on a large scale in northern Chihuahua. The above brief review is not intended to be complete, although the amount of study that has been devoted to methods which probably were used in primitive agriculture is surprisingly small.

During the spring of 1939 some preliminary field studies pertaining to primitive conservation practices were started, and it is hoped they may be continued as opportunity offers. Material assistance in this

MAP OF THE PUEBLO PLATEAU

FIGURE 1.

After Map by School of American Research — University of New Mexico



PUEBLO CULTURE AREAS

I-Rio Grande II-San Juan III-Little Colorado IV-Gila V-Mimbres Chihuahua

[4] Prehistoric Irrigation in Arizona, by O. A. Turney. Arizona State Historian, 1929.

[5] Ancient Life in the American Southwest, by E. L. Hewett. New York. 1930.

[6] Prehistoric Settlements of Sonora with Special Reference to Cirros de Trincheras, by Carl Sauer and Donald Brand. University of Colorado Publications in Geography, vol. 5, No. 3.

[7] Personal communication from Donald Brand, 1939.

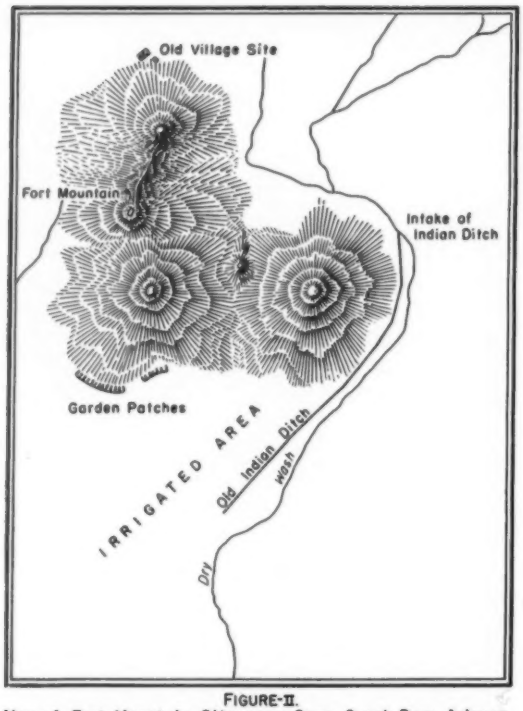


FIGURE-II.
Map of Fort Mountain Site near Cave Creek Dam, Arizona.

work has been given by friends and co-workers in the Soil Conservation Service in Region 8, as well as by a number of scientists in the Universities of New Mexico and Arizona, and by the W. P. A. Writers Project at Phoenix, Ariz.

First, a survey was made of agricultural methods employed in the Upper Rio Grande from Acoma to Taos. In general the agriculture was found to consist of an irrigation method handed down from the Spaniards and showing little early native influence.

Next, work was taken up in the Gila Valley adjacent to Safford, Ariz. On the benches above the Gila stream bed a number of interesting examples of the use of water-detention structures had been reported verbally. One of these sites, located on the bench above Pecks Wash some 2.8 miles from Pima, was examined intensively by John Cole and the writer. On this area somewhat over 25 acres is laid out, with simple water-detention boulder dams forming a complete spreading system. In the upper part of the area the detention structures were roughly rectangular in shape, varying in size from 8 by 10 feet up to 24 by 30 feet. Today there is no evident source of water for this spreader system, though it appears possible that an old washout may have changed completely the course of a former supply stream. Farther down the slope a distinct system of terraces had been laid out on a grade of 2½ to 3½ percent. The terraces varied from 14 to 18 feet in width and 180 to 225 feet in length. Soil profile studies showed that the terraces were stabilized by one line of boulders which were either matched together or overlapped.

A series of sites near Deadman's Gulch, on Graham Mountain in Arizona, was examined next. Here early terraces had been constructed, apparently by clearing the land and piling the boulders at the outer edge of the terrace. The size of the terraces was very irregular, varying from small areas of 20 by 40 feet up to approximately 30 feet wide and over 100 feet in length. Portions of this same section were examined by Dr. Haury [8] and have been dated for probable time of occupancy by pottery shards at A. D. 1200 to 1400.

A short study was made of portions of the old Indian irrigation ditches north of Phoenix.[9] Here portions of the extensive old ditch system for diverting water from the Salt River, which was mapped by Turney,[10] could still be seen. The main canals, dug by hand, were approximately 30 feet wide and 6 to 8 feet deep. The distinctive feature of these canals is the relatively level gradient which apparently necessitated the construction of branch or alternate portions of the system as the main channels filled with silt. Many parts of the banks showed the calcareous deposits noted by Haury [11] in his excavation of the Snaketown system adjacent to the Gila River.

At the northern edge of the Salt River Valley, near Cave Creek, an extremely interesting example of early agricultural practice was examined. This was the so-called Fort Mountain site shown in figure II. Here a small village was located at the base of the large hill. A refuge fort with walls 4 to 5 feet high and about 4 feet thick, made from piled-up boulders, was located on top of the hill. A simple diversion ditch, probably for flood-water irrigation, brought water from the adjacent creek and conducted it to a tract of some 30 to 40 acres which could have been irrigated easily by this means. At the base of the hill a number of simple boulder water-retaining dams were noted; by means of these dams, flash run-off could have been utilized to raise garden crops such as beans, squash, or chile peppers. At first it seemed strange that the house site was chosen on the opposite side of the hill from the cultivated area, but it was found that the best trail to the mountain

[8] Report to Soil Conservation Service, Tucson, Ariz., by Emil Haury.

[9] J. W. Simmons of the W. P. A. Writers Project, Phoenix, Ariz., gave the writer valuable assistance in finding this area as well as in locating the Fort Mountain site and other places examined north of Phoenix.

[10] See footnote 4.

[11] The Snaketown Canal, by Emil Haury, University of New Mexico Bulletin 296 936.

fort led from the village up this side of the hill. When the fort was reached the entire cultivated area could be easily watched and the presence of human or animal intruders readily noted. Pottery shards dated this site at from A. D. 1000–1200.

A series of sites on New River, Upper and Lower Alkali Wash, Agua Fria Cañon, Bishop Creek, and Hackberry Wash were next visited. Here were found simple boulder terraces of varying sizes and relatively similar in design to those on Graham Mountain. The most notable departure from this scheme was the group of terraces at Bishop Creek, shown in figure III. They appeared upon examination of the profile and the scheme of construction to be of an agricultural type. The contour of the terraces varied from practically level to a grade of 2 to 3 percent with a vertical interval of 2½ to 3½ feet. The walls were of rough boulders which were still largely in place, though a few breaks had occurred. All the other terraces examined up to this time had some upper drainage to furnish a possible water supply. This was not the case at Bishop Creek. The terraces lay on the west slope above the cañon and were adjacent to the village site. At present there is no visible water supply, and it is doubtful if the rainfall is sufficient at all times to produce crops without supplementary run-off.

Collections of pottery shards were made at most of the sites visited. The collections were classified by Dr. H. P. Merra of the Laboratory of Anthropology at Santa Fe and the following approximate datings were given the sites by this method: At the New River site the pottery consisted of Roosevelt red ware of the period A. D. 1000–1200. At Hackberry Wash the pottery consisted of Salada red ware, of the same period. At Upper and Lower Alkali Wash, the pottery was again Roosevelt red ware, probably made prior to A. D. 1300. The Bishop Creek and Agua Fria sites were the most recent, yielding pottery that was manufactured some time prior to A. D. 1400.

A visit was made later to Mesa Verde where an interesting example of conservation practice was examined by Watson of the local Park staff and the writer. Here, on two branches of Soda Canyon, a series of dams had been laid up with relatively flat rock. The method of construction was notably different from anything

(Continued on p. 131)

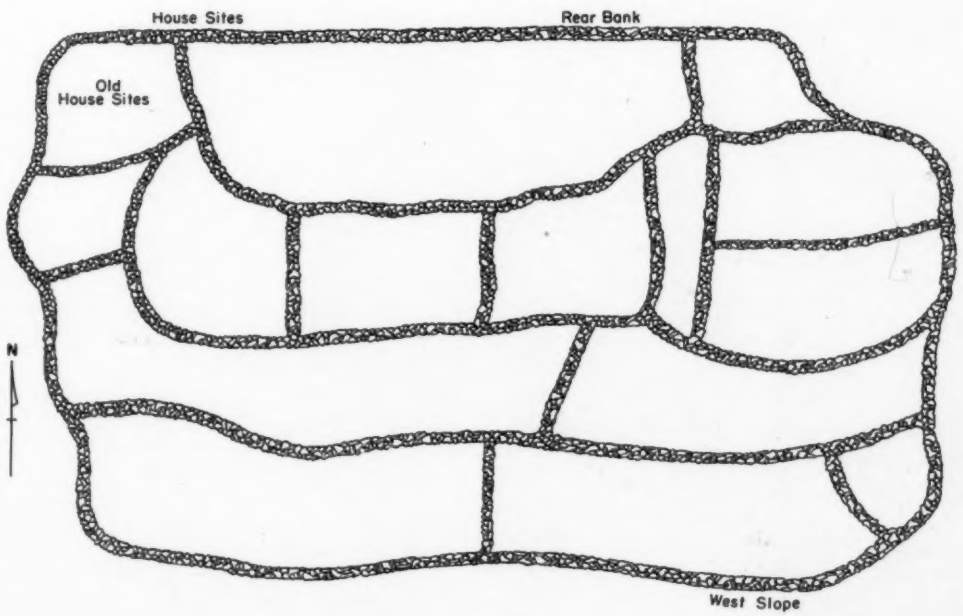


FIGURE - III.

WATER FACILITIES FOR THE

HE ARID AND SEMIARID WEST

WHEEL CHARTS FOR AGRONOMY

By HARRY H. GARDNER [1]

THEY eliminate mistakes, they save time and trouble, all with a simple flick of a finger.

"They" are two small cardboard discs, parts of two new charts developed at the Fennimore, Wis., project. One provides accurate information for land-use planning, and the other at a glance supplies pertinent seeding information for more than 40 crops. The charts are similar to the "geography wheels" so frequently used by school children. They have come into unlimited use at Fennimore, have ousted completely the older land-use tables.

Before the older table charts were available, each planning technician planned according to his individual opinions because he had no tabular guide. To correct that situation, in 1938 regional technicians met with field technicians in projects and developed sets of land-use tables for all work areas. The tables listed the recommended uses for all classes of land and indicated the rotation and supporting conservation practices suitable for cropland by the various degrees of slope, soil type, and erosion.

The land-use table gave the planning technician a badly needed guide based on the studies and opinions of all technicians interested in the particular work area. So successful were the tables in the projects that project technicians assisted C. C. C. camp technicians in developing a similar planning guide for each of the camp work areas.

It was found, however, that in a work area having many soil types, degrees of slope, and stages of erosion, the table became too complicated for general use. It was difficult to read the columns of an extensive table across and then from top to bottom, and these difficulties, noted at the Fennimore project, resulted in the development of the new wheel charts.

Based on soil-type, slope, and degree-of-erosion studies made by technicians of the area and the region, the wheel chart for erosion control gives the complete information carried by the old land-use tables. In addition, it provides the boon of greater convenience, as no tiring column inspection is necessary, and mistakes cannot be made. The old land-use table-chart showed recommended crop rotations and supporting conservation practices just as does the new erosion wheel. By adjusting the new wheel chart to the physical conditions represented, the technician may read quickly what land-use, rotations, and supporting practices are recommended.

The Fennimore chart is merely two pieces of paper. One of them is round—about as big as the bottom of a pie tin. The other is rectangular and about the size of an ordinary piece of typing paper. On the round piece, or disc, an arrow drawn straight from the center to the outer edge points to soil types and slopes on the rectangular sheet. Six small windows make a line across the diameter at right angles to the arrow.

In use, the arrow is turned to whatever soil type the technician finds indicated on the conservation survey map for the particular field on the farm being planned. A slight adjustment to the degree of slope existing on the field is necessary.

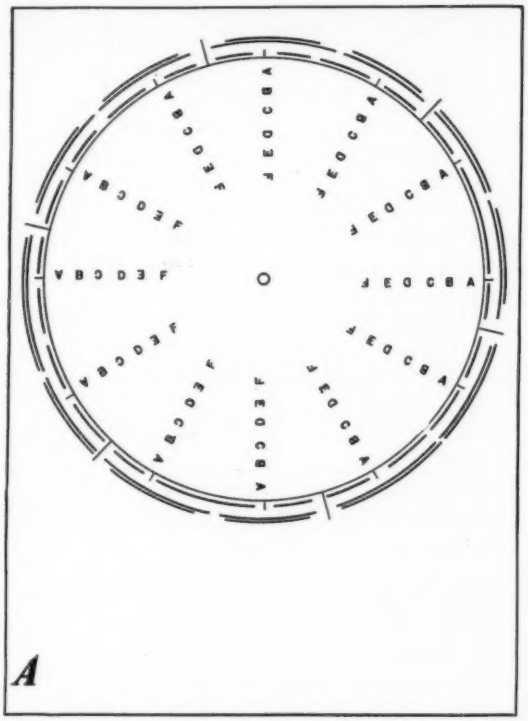
After the chart is set for the proper slope and soil type, the technician makes a finer adjustment, so that the degree of erosion existing on the field is indicated in the first window to the right or left of the arrow. The technician may then read, from the other two chart windows on the same side of the arrow, the recommended rotations and the conservation practices needed to support the rotation on that particular field.

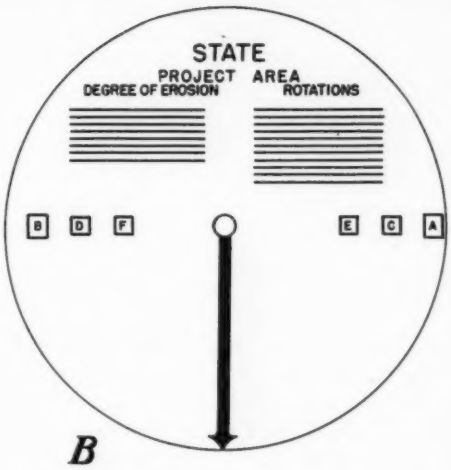
For example, if a technician knows that on a certain piece of land the soil is Tama silt loam, that the slope is 2 to 10 percent, and that the topsoil is 25 to 75 percent eroded, with occasional gullies, the wheel chart indicates three type rotations recommended for these land conditions and that the rotation should be supported by strip cropping or terraces. The wheel chart tells him that he should plan a 6-year rotation of corn, corn, small grain, and alfalfa-grass meadow for 3 years, with a rye cover crop between the two crops of corn. Or, he may plan an 8-year rotation of corn, small grain, corn, small grain, and alfalfa-grass meadow for 4 years, with a sweetclover catch crop plowed under before the second corn crop. A 4-year rotation of corn, small grain, and legume-grass meadow for 2 years is also recommended.

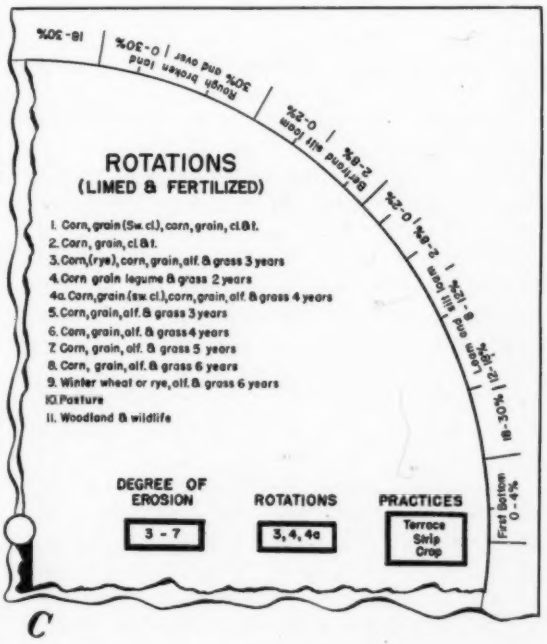
The chart does not prevent him from planning longer rotations of alfalfa and grass, nor does it eliminate the possibility of putting the land into permanent pasture or substituting winter wheat, rye, or other close-growing grain for corn.

With this basic information, the technician is prepared to consider the economic side of planning the erosion-control program for a farm. The planning technician and the farmer must agree on a rotation that

[1] Regional agronomist, Soil Conservation Service, Milwaukee, Wis.






ROTATIONS
(LIMED & FERTILIZED)
1. Corn, grain (Sw. cl.), corn, grain, cl. & l.
2. Corn, grain, cl. & l.
3. Corn, (rye), corn, grain, alf. & grass 3 years
4. Corn grain legume & grass 2 years
4a. Corn, grain (sw. cl.), corn, grain, alf. & grass 4 years
5. Corn, grain, alf. & grass 3 years
6. Corn, grain, alf. & grass 4 years
7. Corn, grain, alf. & grass 5 years
8. Corn, grain, alf. & grass 6 years
9. Winter wheat or rye, alf. & grass 6 years
10. Pasture
11. Woodland & wildlife
DEGREE OF EROSION
3 - 7
ROTATIONS
3, 4, 4a
PRACTICES
Terrace
Strip
Crop
Rough broken land 30% and over | 0-30%
Brittons silt loam 2-6% | 0-2%
Lenoir and silt loam 6-12% | 2-6%
18-30%
First Bottom 0-4%
C

The wheel chart consists of two parts, a card designated here by the letter A, and a disc, B. On the card A, the letters represent: A and B, practices; C and D, rotations; E and F, degree of erosion. Around the circle, indicated in this sketch by short lines, appear designations of soils and slopes. The windows denoted A, B, C, D, E, F on the disc B are cut out to allow a view of the information on the card. With the disc mounted on the card so that it may be revolved around its center, the arrow is brought opposite the required soil and slope, then through the windows may be read directly the practice A and B, and the rotation numbers under C and D for the degree of erosion as seen through the windows E and F.

will give suitable economic return without permitting serious soil depletion. With the rotation outlined, the next thing to plan is the conservation practice necessary to support that rotation on this particular field. Here the planning technician must rely on his technical training and experience. For one set of conditions strip cropping may be the most desirable supporting practice; while for other conditions it may be necessary to use terraces or a combination of terraces and strip cropping. Contour tillage is recommended for all cropland.

The wheel chart cannot include such factors as length of slope, shape of field, location of field in relation to other fields, farm buildings, other permanent improvements, water for livestock, and many other problems that must be considered in the development of a complete soil conservation plan for a farm.

To Joe Pierre, project agronomist at Fennimore, goes the credit for this new data-presentation idea. To use his own words, "The land-use wheel chart gives identically the same information as the more complicated, more involved land-use tables. Soil type, slope, and

(Continued on p. 131)

PLANNING FOR THE SOUTHERN GREAT PLAINS

By ROY I. KIMMEL [1]

DUST storms make news, and although their damaging effects may have been exaggerated, they have served to tag the Southern Great Plains a serious problem area in the public mind.

Let us look at the facts.

Throughout western Kansas, eastern Colorado, northwestern New Mexico, and the Panhandles of Oklahoma and Texas, the average rainfall is 20 inches or less. In most other agricultural regions of the United States it is 20 inches or more—ordinarily, much more. Furthermore, it is not unusual for the rains in the Southern Great Plains region to come in torrents, when vast quantities of water are washed toward the Gulf of Mexico almost as fast as they fall.

Add to these facts the history of the Southern Great Plains for the last 60 years. It is a story of exploitation, first by overgrazing and then by heavy planting to wheat, and when the droughts came some observers expressed doubt as to whether the region could survive as farming land. There was even talk of moving the population to other parts of the country.

The Southern Great Plains contain some 97,000,000 acres, of which 65,000,000 are in pasture and 32,000,000 in cultivation. It is estimated that at least 6,000,000 of these 32,000,000 acres should go back to grass, either because they were originally and are still unsuited to cultivation or because they have been too seriously damaged to remain in cultivation. That leaves 26,000,000 acres which we now feel sure of as land that can be profitably maintained in cultivation, provided proper remedial measures are instituted.

No longer is there talk of wholesale abandonment of the area. Since 1936, when the President's Great Plains Committee made a comprehensive study of the problem and outlined a general plan of action, various Government agencies have been enthusiastically carrying out programs consistent with the recommendations. Today it can be said that substantial progress has been made toward the reconstruction of Southern Great Plains agriculture. In this work the Soil Conservation Service has had an important part.

Effort to date has been concentrated on two basic problems, (1) the elimination of wind erosion, and (2) the development of a stable system of agriculture that will bring a greater degree of security to a region where production hazards are acute.

Fundamental to the job of controlling wind erosion is that of learning to save all the rain that falls. How to do this is being shown on Service demonstration areas in western Kansas at Liberal; in Colorado at Springfield, Cheyenne Wells, and Colorado Springs; and at several places in the Panhandle of Oklahoma, northeastern New Mexico, and the Panhandle of Texas. These demonstrations, carried on cooperatively by farmers and the Service, have not only performed a useful service in showing how to control wind erosion, but also have shown that crops can be grown even in the driest years provided proper water conservation practices are used. In 1937 crops were raised on the Soil Conservation Service project at Dalhart, Tex., equaling any produced in the wettest years. In this instance the cover crop was the money crop.

Henceforth one of the principal objectives of the Service in the Southern Great Plains will be to provide assistance to soil conservation districts as they become established. The soil conservation district, as authorized by the enabling laws of the different States, provides farmers with the most effective instrument for carrying out their own program that has thus far been worked out. The Soil Conservation Service is prepared to make available to districts, once they are organized, various types of assistance. For example, the technical men of the Service who hitherto have been employed on demonstration projects will be available to districts to make conservation surveys, render engineering services, plan for erosion control, etc. Where a C. C. C. camp exists in the vicinity of a conservation district, it will be used to further the district program. Seed and planting stock will be furnished, equipment lent to carry out desirable operations. As the district idea grows, agencies other than the Soil Conservation Service will be able to contribute to the district program.

Among the other programs of the Department that will tend to prevent recurrence of wind erosion is the water facilities program authorized by the Pope-Jones Act of 1937. This program is designed to provide, through loans to producers, water facilities to both individual farmers and to groups of farmers. The type of construction ranges from pump wells for supple-

[1] Chief program analyst, Bureau of Agricultural Economics, U. S. Department of Agriculture, Washington, D. C. (Formerly Coordinator, Southern Great Plains. U. S. Dept. of Agr.)

mental irrigation to the building of small dams for stock use.

Once an area has been approved for the development of water facilities, the Soil Conservation Service has the responsibility for working out with individual farmers just what kind of facility is desirable. The Farm Security Administration provides the funds by which it is to be financed. In some instances, the Service does the work; in others, a contract will be let—the particular procedure depending upon which seems to be the most economical approach.

Wind erosion, of course, is but a symptom of an unsound agricultural economy. The second problem facing the Southern Great Plains, therefore, is that of working toward the kind of farming that gives a decent income and a better kind of life to the farmers in the region.

The initial step in the solution of this problem followed the realization by the Farm Security Administration that in large parts of the area wheat cannot be depended upon as a major source of income to the farmer. The Farm Security Administration had learned that repayments on wheat loans, with few exceptions, came from farmers who carried on a mixed type of farming. In meeting the emergency conditions of the earlier drought years, the Farm Security Administration and its predecessor had loaned millions of dollars to farmers for the production of wheat; and most of this money could not be repaid.

The Farm Security Administration now bases its policy for wheat loans on the moisture content of the soil at planting time. The soil must have a moisture penetration at seeding time to a depth of at least 2 feet before this agency will make a loan to a farmer. Certain areas with a poor history in wheat production, even in wet years, the Farm Security Administration concluded, should be allowed no wheat loans at all.

In addition, it was found that the few farmers who had been able to earn a decent living through depression and drought were, with almost no exceptions operators with holdings running into 3 or 4 sections of land. It was found, too, that most of these holdings were in grass, with the cultivated acres of the farm used for the production of supplemental feed. This and similar realizations led to the inauguration, early in 1938, of the unit-reorganization program, one of the most significant developments in the building of a sound agriculture for the Southern Great Plains.

The idea behind unit reorganization is diversified farming carried out on a sufficient acreage to ensure an acceptable income in dry years as well as in wet years.

Because in a reorganization of this kind the income during the first few years of operation is small, Secretary Wallace authorized the Farm Security Administration to extend the length of time for repayment of loans from 5 to 10 years in instances where long-time leases could be obtained. Most of the units developed have involved ownerships by four or five different persons, with the new units ranging in size from 2,000 to 4,000 acres as opposed to the unit in one section or less that prevailed in the past. This calls for, say, 300 or 400 acres for production of forage crops and possibly 100 or 200 acres for wheat where wheat has a place in the program. The rest is in grassland and former cropland returned to grass.

It is noteworthy that the Farm Security Administration's need for technical help to work out conservation programs for the reorganized farm units was met by the Soil Conservation Service, which has assigned technical personnel to cooperate in developing this phase of the work.

The Farm Security Administration will lend the farmer money with which to buy a foundation herd of livestock and necessary equipment and to provide money for cash leases and operating expenses. The money is advanced as needed, and repayment schedules are set that will allow the farmer to take best advantage of the market prices. Annual home and farm budgets are made for each farm by the local farm security supervisor. Diversification is encouraged with the development of as many productive enterprises on the farm as can be efficiently conducted. Taken into consideration are the contributions and requirements of the entire family. At least 1 year's feed supply is held in reserve. Trench silos, inexpensive to construct, are used.

The plan calls for the farmer to develop water-spreading devices and arrange for stock water. Range surveys are made annually so that the grazing land will not be overstocked. And it is to be noted that farmers may carry out these soil and moisture conservation practices in cooperation with the Agricultural Adjustment Administration program, particularly on the portion of the operating unit that is being restored to grass.

During the last year and a half, 133 farmers have come into this program, the average loan being $1,740. The average change in acreage for these farms has been from around 600 acres in the old unit to 2,500 acres in the new unit. To date, some 300,000 acres have been brought into better use through this program. Three hundred other plans of this type are being worked out at the present time, to be completed in the near future.

Supplementing the unit-reorganization program, the Department of Agriculture has directed its efforts in several other ways toward solution of the problems of the Southern Great Plains.

For one thing the restoration of land in grass, in those areas where most of the grassland has been destroyed, is too costly for the private owner, and requires a considerable period of time before the land has much economic value for grazing. Probably the best use of the submarginal land purchase program under title III of the Bankhead-Jones Act is for the Soil Conservation Service to make its purchases with the reorganization of particular units in mind. The Service can begin restoration to native grass, and as soon as the land is usable, lease it to the farmer for a long time, with the provision that the land be used for grazing purposes only. Such projects already have been established.

For another thing, many landowners would like to restore their land to grass, but they are discouraged by local tax situations. Not only are these tax rates assessed on valuations made during the boom years, but also there is a very small differential between tax rates on cropland and land earmarked for return to pasture. The States could make a considerable contribution toward a stabilized agriculture for the region if they found it possible to tackle this problem.

Already considerable progress has been made toward tax adjustment in one State—Colorado. Last year the Bureau of Agricultural Economics and several county planning committees looked into the tax situation in a number of counties in the southeastern part of the State. Representatives of the Bureau discussed the matter with the Governor of Colorado. As a result, he called the State tax commission to discuss the matter further; the commission made recommendations to the counties for lines of action in tax adjustments; and results were forthcoming.

It is hoped that as time goes on, the aid advanced by the Department of Agriculture toward the solution of the problems of the Plains farmers will be greatly increased. But while the Department can do a great deal, the final responsibility lies with the farmers themselves.

From now on, as Dr. Bushrod W. Allin has explained in an earlier issue of Soil Conservation, the farmer is going to be able to take a more active part in program making, and to have the benefit of a greater volume of technical help in so doing than he has in the past. The machinery for farmer planning is being set up in every agricultural county in the United States and farmer-drawn recommendations already are beginning to arrive in Washington.

As county planning committees function more effectively, they can bring the practical experience of farmer members to bear on the necessary readjustments in the Southern Great Plains. In certain counties of the region, these committees have already taken the initiative in carrying out the unit-reorganization type of adjustment. For instance, in Elbert County, Colo., several unit reorganizations have been carried out where no Federal loans were necessary.

Again, the land-use classification map of Beaver County, Okla., and the county committee recommendations as to size and type of farm in each use-class area, are being used by the county supervisor of the Farm Security Administration. Farm management plans, which form the basis upon which the Administration loans are made, have been drawn up in accordance with the committee's recommendations.

These are hopeful signs. They show that Southern Great Plains farmers, out of their long years of experience on the land, have a definite contribution to make to the building of plans for the region.

If farmers can work for their own salvation, the Federal Government and the State governments will give the necessary assistance. In the long run, the reconstruction of Southern Great Plains agriculture is a job of cooperation.

Erosion-Control Lessons From Old-World Experience

II. FISH PONDS AND FIELDS IN ROTATION

By W. C. LOWDERMILK [1]

Bringing in the crop of fish in net baskets, to be placed in tanks of fish merchant or in small holding pond. The basketful weighs about 70 pounds.

FISH culture in ponds is becoming more and more important in the United States. Thousands of ponds throughout the Nation are devoted to a comparatively new farm enterprise in this country. The experience of older countries for centuries in fish culture will be of special interest and value to American agriculture. The rotation of fish culture with field crops constitutes a unique method of land use to be found in many parts of France. The method reaches its highest and most intensive development in the region of Les Dombes, Province of Ain, lying between the Saone and Rhone Rivers above their junction and north of Lyon. In this region ponds are strung like beads on the drainage channels of shallow valleys.

Topographically the region in question is a broad flat dome sloping from Villars, a town near the center, toward the Saone and Rhone Rivers in gentle gradients of 1 to 2 percent. The area of approximately 250,000 acres is drained by broad shallow valleys marked originally by occasional marshes; thus the land lends itself to the impounding of waters by comparatively low cross dikes or dams. It is said that prior to the fourteenth century the area was covered with forests, and that the original clearing was for agricultural crops. The natural fertility of the soil is low so that the area is not highly productive of the usual agricultural crops of this region.

The soil, as well as the topography, is especially suited to the impounding of water in shallow ponds of considerable areas. The origin of soil material is disputed, although it is associated with the terminus of the great ice sheet of the Wormian Glaciation which moved down the Rhone Valley as far as Lyon. The soil is a heavy clay of low permeability.

The climate also favors this strange adaptation in the use of agricultural lands by supplying an annual average rainfall of about 30 inches, varying in rare extremes from minima of 18 inches to maxima of 40 inches. Precipitation is favorably distributed throughout the year—it averages 1.36 inches in January to 3.6 inches in September—to supply necessary quantities of water to keep down evaporation as well as to replenish losses. An average annual relative humidity of 72 percent also prevents excessive evaporation loss of water from pond surfaces.

The development of fish culture in this region dates back to the Middle Ages; it was well established at the time of the first written record of it in 1570. The origin of this interesting combined use of land and water is said to have been due to serious depopulation of this part of France by wars of the fourteenth century, which at the same time brought on a serious shortage of agricultural labor. Landlords, following examples set by abbeys, introduced the culture of fish in natural ponds; and later when it was found to be productive and profitable they extended the method to artificial ponds impounded by comparatively low dikes across shallow valleys.

Thereafter this method of combined land and water use developed extensively until in the eighteenth century, when the population began to suffer from numerous maladies, including malaria. The death rate ran high, to alarming numbers. The ponds of Les Dombes region were considered the origin of these maladies, whereupon laws were passed to restrict numbers and use of fish ponds. Under a number of laws beginning with that of July 21, 1856, the area in ponds was reduced from 48,000 to 21,600 acres by the end of the century. When it was discovered that the sickliness of the population was due more to malnutrition than to malaria, and with improved conditions of public health, the restrictions on fish culture were relaxed. Since 1904 fish culture has increased until in 1938 approximately 30,000 acres are devoted to this purpose. The industry is now thriving and proving more profitable than the production of field crops.

[1] Assistant chief in charge of research, Soil Conservation Service, Washington, D. C.

Les Dombes area, Province of L'Ain, France.

Two types of land use prevail in Les Dombes, corresponding to the adaptabilities of the land. Higher land above pond levels is devoted chiefly to permanent pasture for the production of livestock, while the floors of the broad shallow valleys are dedicated to the rotation of fish culture and field grain crops.

The pastures, at the same time, yield run-off from the rainfall to fill and replenish the ponds. Experience dictates that the catchment area must be not less than six times the pond area which it supplies. Moreover, it is necessary to conserve the run-off from the catchment areas. When a pond higher up the drainage is emptied, the water is caught in a field lower down to form a fish pond. The farmers make use of the same water as it is passed progressively down the drainage, from field to field, until finally it is discharged into a main drainage.

An assured water supply is essential to this rotation of pond-field culture and it has a value, even as has the land. Though not stipulated in deeds, the rotation of pond and field down a valley is definitely set by rigid custom. Failure to respect successive right to the use of pond waters occasionally leads to sharp litigation. In general, however, farmers can depend upon the water being turned into their fields in accordance with the unwritten but time-honored custom.

Of the total area of 250,000 acres in Les Dombes region, 40,000 acres are devoted to fish and crop rotation; between 25,000 and 30,000 acres are constantly in water surface. The remainder of the area is in permanent pasture, occasional grain crops, orchards, and hay.

Land features influence the size of ponds, which varies from 30 to 600 acres; the usual size falls between 50 and 100 acres. The average depth of fish ponds is between 7 and 10 feet with a maximum of 15 feet. In isolated ponds, the treatment in a rotation is not so definitely fixed as it is for ponds in series set in a drainage.

Dikes, or earthen dams, across valleys are well constructed, with thoroughly tamped cores, and are fitted with gates and spillways. Overflow from a pond is by-passed in special canals down the valley where it may be diverted through intake gates into one or more ponds deficient in water. The dikes also serve as elevated roadways across the valley. Ponds bordered by streams are well situated for water supply to supplement the discharge from emptied ponds up the valley.

The usual rotations for Les Dombes region are 2 years in water and 1 year in grain, and 2½ years in water and ½ year in grain. In other parts of France this rotation may be varied more readily than in Les Dombes where rights to successive use of water by farmers lower down the drainage fix the rotation more rigidly than in a less intensely developed region.

A number of species of fish are grown in these ponds, of which the following are most important: Carp (*Cyprinus carpio*); tench (*Tinca tinca*); pike (*Esox lucius*); and whitefish (*Coregonus clupeiformis*).

Sometimes other species such as eels and catfish, get into the ponds by accident. Eels are welcomed, but so destructive are catfish that every effort is made to eliminate them from the ponds. Carp make up about 50 to 60 percent of the stocking. In recent years a new strain of carp without scales has been introduced and it is found to be more productive than the carp with scales; it increases in weight 2 to 2½ times that of the usual or scaly variety.

Nursery ponds are stocked with mother fish, which are specially guarded and protected. The ratio of male to female is 5 to 2 in the nursery ponds. Each

mother carp will deposit about 200,000 eggs which hatch in May.

Young fish for stocking ponds are raised in special and small nursery ponds which may or may not be permanent. The fish are given special names to designate their age and size, as follows:

Fish at 6 months are called "feuille," weight about 10 grams.

Fish at 18 months are called "panot," weight about 100 grams.

Fish at 30 months are called "poisson," weight about 2,000 grams. The 2½-year-old carp, weighing 2,000 grams or 4.5 pounds, is ready for the harvest and the market.

Ponds are stocked at the rate of 1,600 feuille per hectare, 600 of which are allowed for losses. The carrying capacity or stocking of a hectare is placed at about 1,000 net. A year later the ponds may be seined to collect the "panot" or 18-months-old fish for redistribution so that each hectare of pond shall be stocked with the so-called "100" of panot which in reality is 160, allowing 60 for possible losses during the coming year. Extra panot above those needed for the pond are transported for stocking in other ponds. In a year the panot gain 20 times their weight at 18 months, i. e., from 100 grams to 2,000 grams. One hundred full-sized fish at an age of 2½ years are often harvested from a hectare of water surface. This is 200 kilograms or 440 pounds of fish—176 pounds per acre.

Records on a pond of 450 acres, from 1850 to 1880, showed an average production of 146 pounds per acre. Since then production has averaged 164 pounds per acre. This weight was made up of:

	Percent
Carp	55
Tench	25
Pike	3
Whitefish	17
Total	100

It is interesting to compare the production of beef on permanent pasture in this region; it has averaged 149 pounds per acre per year. The poundage of meat production favors fish culture, as do also the outlay for labor and the net income.

The fish find their food in the abundant faunal life of the ponds. For some time it was thought that the fish fed upon the vegetation submerged in the ponds. Life history studies by Professor Leger of Grenoble have proved that this assumption is incorrect and that actually the fish are carnivorous; they live on plankton, and on the insect and crustaceous life which thrives on vegetable matter and living plants in the water. The carp is a rooter; drained ponds disclose rough ground where carp have rooted in the bottom of the lake for food, as a hog in the forest floor for acorns.

Experience shows that it is inadvisable to feed fish; sufficient food is to be had in the shallow ponds, and the exercise in search of it ensures a firmer and better quality of flesh on the fish.

Occasionally it is desirable to apply basic slag to a pond to add phosphorous, but more especially to neutralize the water, since these species of fish flourish best in neutral or slightly alkaline water. For this reason it is best not to have forests within the drainage area—sour or acidified waters would flow from forest land into the ponds—and accordingly, drainage areas or catchment basins are usually left in pasture. Likewise it has been found that it is inadvisable to allow the pond vegetation to grow out of the water, and the plants are therefore mowed at the surface of the water. A mowing machine attachment on boats is used for this purpose.

The fish are harvested in the spring and in the autumn—most often in March so that a crop of summer grain may be sown in the pond area. When a farmer decides to harvest his fish crop in a pond he arranges with a fish merchant and his neighbors for a date suitable to all. At the hour set, in accordance with the time-honored right of succession, the gate in the dike is opened and the water is allowed to escape from the pond into a field lower down the drainage. When the water surface is reduced to a comparatively small area the gate is shut, and the harvest proceeds by seining the reduced pond. The fish are collected and placed in a trough full of water, from which various species and categories of sizes are divided, placed into baskets of netting and carried, some to the fish merchant's tank on his wagon or truck, and others into small holding ponds from which they will be transferred later to other ponds for stocking.

Usually it requires about 10 men working 6 hours to harvest the fish from a large pond of 60 to 90 acres. In less than 1 day's work it is possible to harvest a crop which has grown for 1 or 2 years on this watery field. The yield from the water crop of the rotation is greater than the yield from the grain crop of the rotation. The rotation to field crops is desirable to provide conditions for fish food and in turn the fish fertilize the grain crop.

After a spring harvest of fish and when the area is sufficiently dried out, the land is plowed into narrow strips, three times around, and sown, usually to a

A pond being drained, disclosing the lands of former cultivation. The valley is shallow, suitable to impounding waters with low dams or dikes.

crop of oats. The oats are harvested in July or August and then the field may be flooded in the fall and again put to fish culture for a period of 2 or 2½ years. When the harvest takes place in the fall the land is plowed or left fallow throughout the winter and then plowed in the spring for a grain crop, usually oats or spring wheat. At times the shallow portion of the pond may be sown to a mixture of clover and grass for production of hay. In some instances the field-crop phase of the rotation may be extended to 1½ years, but the most common practice in Les Dombes is 2½ years of water and ½ year of field crops in oats—2½ years wet culture and ½ year dry culture.

The rotation of fish pond to field culture in Les Dombes represents the highest type of land use for the area under present conditions. The soil of Les Dombes is normally poor for agricultural crops, but when flooded for production of fish, in the manner described, it forms the basis for profitable land use. Furthermore, fish culture requires less labor than ordinary agricultural crops; it is especially advantageous during these times of scarcity of agricultural labor in France. It is possible for a farmer and his son or one helper to manage farms of considerable size. We visited one farm of nearly 300 acres which is managed by a man and his son without hired labor, except for the 1 day of fish harvest when he calls in his neighbors. But he in turn helps his neighbors when they require it and the farmers are thus able to carry on their fish culture without additional hired labor. This type of land use is on the increase rather than on the decrease—it is now being extended to other portions of the country where conditions are favorable for storing water in ponds for the production of fish.

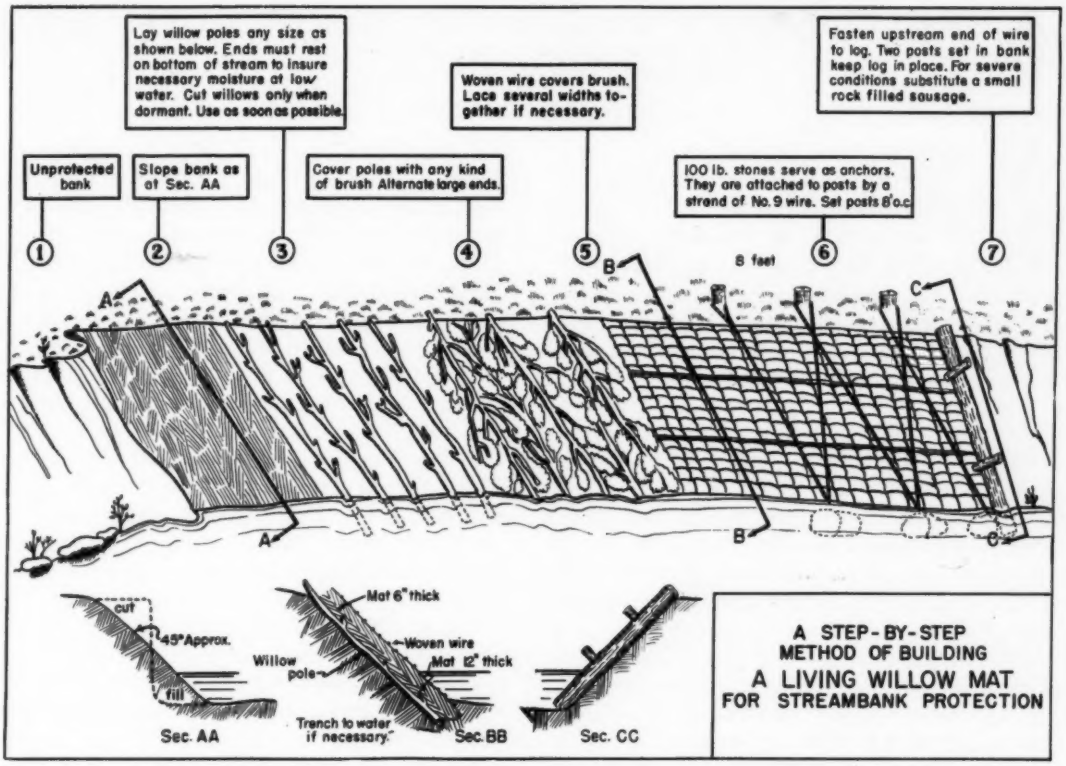
WATER FACILITIES PROVIDED

Fifty-four water facilities areas of the Department of Agriculture, in 17 of the Western States, have been established in cooperation with local and State planning agencies. Farmers and ranchers of these arid and semiarid States receive help in financing and developing their small water supplies—stock ponds, irrigation wells, pumps, and springs—for livestock, crop, and domestic use. Groups of farmers construct water facilities that are too large for individual undertaking.

The farmer or rancher agrees to carry out a soil and water conservation program planned by technicians of the Soil Conservation Service. After that, he may be the recipient of Federal aid. The Service is responsible for the operations phase of the water facilities program. To reduce water deficiency and cost of operations, the Service furnishes technical assistants to relocate lateral ditches, to find locations for concrete drops to prevent water channels from washing out, and to space the field laterals close enough together to prevent over-irrigation on the upper parts of the field.

The water facilities program has progressed rapidly. Requests from more than a thousand applicants have been received for establishment of additional areas. Approximately 800 farm families of the West are now receiving benefits from the program.

The county agricultural agents, or the nearest officials of the Soil Conservation Service and the Farm Security Administration, have available information on how to obtain help in developing water supplies in the Western States.


Lay willow poles any size as shown below. Ends must rest on bottom of stream to insure necessary moisture at low water. Cut willows only when dormant. Use as soon as possible.
Woven wire covers brush. Lace several widths together if necessary.
Fasten upstream end of wire to log. Two posts set in bank keep log in place. For severe conditions substitute a small rock filled sausage.
Unprotected bank
Slope bank as at Sec. AA
Cover poles with any kind of brush Alternate large ends.
100 lb. stones serve as anchors. They are attached to posts by a strand of No. 9 wire. Set posts 8' o.c.
1
2
3
4
5
6
7
8 feet
A
B
C
cut
45° Approx.
fill
Willow pole
Mat 6" thick
Woven wire
Mat 12" thick
Trench to water if necessary
Sec. AA
Sec. BB
Sec. CC
A STEP-BY-STEP METHOD OF BUILDING
A LIVING WILLOW MAT
FOR STREAMBANK PROTECTION

WILLOW MATS HALT STREAMBANK EROSION

By L. B. MOREHEAD [1]

THE Ohio Valley region of the Soil Conservation Service has developed a method of streambank protection by the use of living willow mats. The method has proved simple, inexpensive, and highly effective. Briefly, the steps involved in construction are as follows:

1. Mats are laid during the time of year when willows are dormant.

2. The eroding bank is graded to about a 45-degree slope.

3. The willow (white, *salix alba*, if possible) poles, of any diameter, are laid about 2 feet apart up and down the slope. The butt ends of the posts are pushed well down into the water so that they will remain in water even during dry weather. Poles extend from the water to the top of the slope. All limbs are removed and poles are placed the day they are cut, to prevent drying.

4. The poles are covered with brush, the bushy tops of which are alternately placed at the top and bottom of the bank. Brush may be of any tree species, but willow lays better. This layer of brush should be built into a mat about 12 inches thick at the bottom (where it goes below the water line) and 6 inches thick at the top.

5. Old woven wire is laid over the mat in horizontal bands and laced together with smooth wire.

6. Stub posts are set about 8 feet apart along the top of the mat. Weights of large rocks, concrete, or other heavy material are placed on the mat at low-water mark and attached to the posts by long No. 9 wires. These wires, extending from the posts at the top of the bank down over the mat to the weights, hold the weights in place and keep the mat in place during heavy floods.

7. At each end of the mat a wire should be fastened to a small log and the log secured to a bank by means of

(*Continued on p. 131*)

[1] Area technician, Soil Conservation Service, Mount Vernon, Ohio.

A PRELIMINARY STUDY OF VARIABILITY OF RUN-OFF PLOTS

By B. H. HENDRICKSON [1]

A NUMBER of run-off plot uniformity tests have been made at several soil and water conservation experiment stations during the last few years, with widely varying results as to uniformity of run-off. Despite all efforts to construct two or more plots as exactly alike as possible, side-by-side, on apparently uniform soil, only a single instance is known to the writer of exact duplication in run-off data obtained.[2]

In constructing a series of new run-off plots at the Southern Piedmont Experiment Station, triplication and randomization will be used in order to increase precision and to provide a valid estimate of error. This article reports very recently acquired preliminary run-off data obtained from some of these plots, with an interpretive discussion.

On the Southern Piedmont Experiment Station near Athens, Ga., with 18 new run-off plots equipped with sheet steel troughs and multislot divisor boxes and tanks, a short uniformity test of run-off variability has been completed. The plots were all located on Cecil sandy clay loam soil, of 7-percent slope. No attempt was made to mix soils or otherwise artificially produce uniformity of plot soils for this extremely variable soil which, to plow depth, is a mechanical mixture of some of the original Cecil sandy loam topsoil with more or less of the plowed-up clay subsoil. This topsoil condition is notoriously "spotty" in field distribution, and extensive in occurrence. During plot construction, the minimum of cutting and filling was done to achieve smooth precise plot slopes of 7 percent. Three slope lengths are represented, of which sets of 6 plots each are 35 feet, 70 feet, and 105 feet long, respectively. All plots are 20¾ feet wide. During pretest, all plots were in oats.

During the pretest period from February 25 to March 30, 1939, eight rains occurred, each of which caused some run-off. Volume of rainfall totaled 7.81 inches for this period, ranging from 0.09 inch to 2.40 inches for individual rains. Rates of rainfall were all classified as "slow," not exceeding 1 inch per hour for a 5-minute period. Such rainfall conditions are likely to produce run-off data of extreme variability, that is, rainfall intensities not much greater than soil infiltration rates may be expected to produce run-off data tending to reflect these infiltration rates, and they are thus most useful in detecting inherent soil differences with respect to water intake. It does not follow that excessive-rate run-off, or run-off computed periodically or annually, will always be subject to interpretation in the same relative terms.

The accompanying table lists the cubic feet of run-off, per rain, from each of the 18 plots, with summarized data, for the pretest period.

[1] Project supervisor, Southern Piedmont Experiment Station, Soil Conservation Service, Athens, Ga.

[2] A single heavy rain produced 58.6 percent run-off from each of a pair of similar ½s-acre plots at the Soil Conservation Experiment Station, Tyler, Tex., in 1933.

Pretest run-off (cubic feet per rain) obtained from 18 plots planted to oats, February 25 to March 30, 1939

Rainfall		Short plots						Medium-length plots						Long plots					
Date	Inches	1*	2	11	12	17*	18*	3*	4	13	14*	15	16*	5*	6	7*	8*	9	10
		Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.
Feb. 25	1.22	5.0	7.6	7.3	5.7	3.0	7.3	26.6	24.9	11.1	4.2	5.7	4.0	12.8	2.6	2.2	2.2	3.8	7.2
Feb. 27–28	2.40	69.2	82.4	76.7	62.4	57.0	66.1	173.3	186.6	135.3	94.0	125.0	81.2	208.1	182.3	112.4	188.4	174.9	202.3
Mar. 1–2	.99	32.7	34.8	35.1	27.0	26.5	30.4	75.8	69.1	51.2	50.8	53.9	50.0	87.1	92.7	55.0	72.4	74.8	64.9
Mar. 6	.23	1.6	.6	1.8	1.9	0	.7	2.5	3.0	.9	1.8	1.7	1.0	2.7	2.1	0	0	2.9	4.9
Mar. 10	.65	18.4	15.3	20.9	13.1	11.0	12.5	30.8	30.3	29.4	24.2	25.0	23.0	46.7	46.0	28.7	37.1	47.1	47.1
Mar. 12	.09	1.6	.6	1.1	.4	0	.1	1.3	1.3	.8	.5	.6	.1	1.6	1.8	0	0	.2	1.3
Mar. 26–27	.67	1.7	.9	1.9	.8	.6	1.3	2.7	3.1	2.4	1.9	2.3	.9	4.0	3.1	.7	0	2.2	4.0
Mar. 29–30	1.33	40.6	39.6	39.4	28.1	29.4	35.4	77.3	69.7	64.2	54.1	64.4	56.1	111.7	106.3	73.1	69.2	87.4	103.3
Totals	7.81	170.8	182.0	184.2	139.4	127.5	153.8	390.3	388.0	295.3	231.9	278.8	216.3	474.7	436.9	272.1	369.3	393.3	435.0
		Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent
Percent run-off for period		36.3	38.7	39.1	29.6	27.1	32.6	41.5	41.3	31.3	24.6	29.6	23.0	33.7	31.0	19.3	26.1	27.8	30.8
Average percent run-off by slope-length groups		33.9 percent						31.9 percent						28.1 percent					

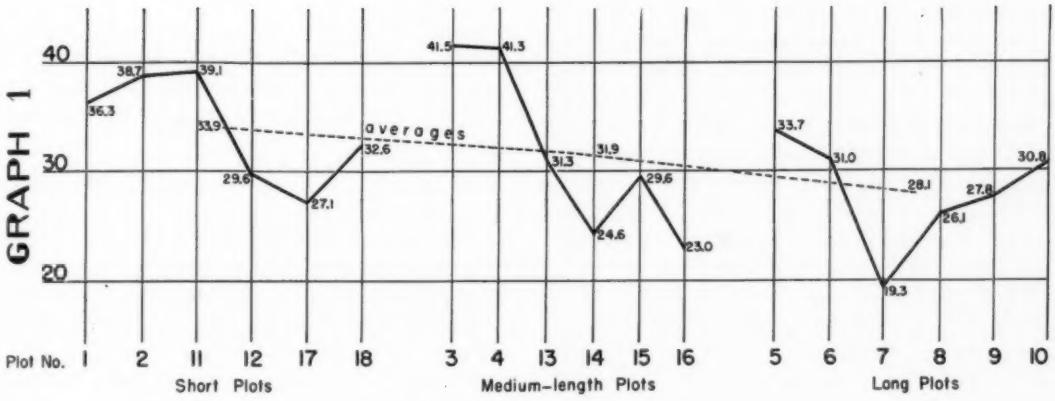
*Plots on which cotton will be planted in the subsequent rotation, with oats-cowpeas on the balance.

VARIABILITY OF RUN-OFF AVERAGES

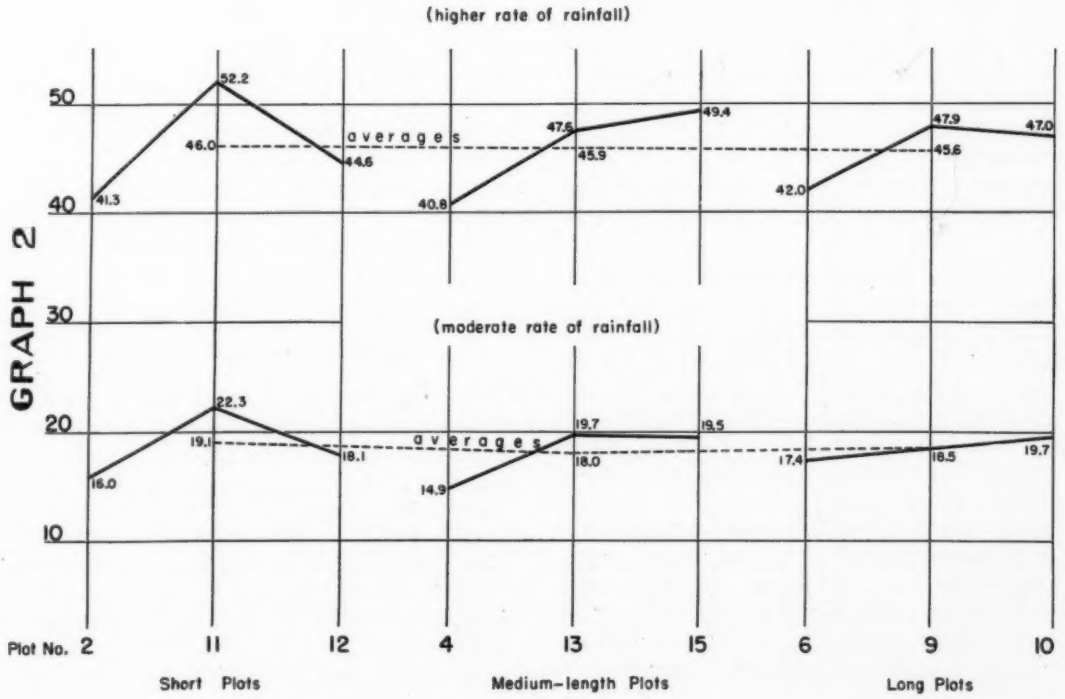
Plots selected for cotton, when in oats pretest period, averaged 32.0 percent (short); 29.7 percent (medium); 26.4 percent (long) run-off.
Plots selected for oats-cowpeas, when in oats pretest period, averaged 35.8 percent (short); 34.1 percent (medium); 29.9 percent (long) run-off.
Differences, when in oats pretest period, averaged 3.8 percent (short); 4.4 percent (medium); 3.5 percent (long) run-off.

Pretest run-off percentages obtained from 18 plots planted to oats

Period: February 25 to March 30, 1939



Run-off percentages obtained from 9 plots planted to oats during two small rains of moderate to high intensities



The plots selected for oats-cowpeas permitted a larger percent of run-off during the pretest period than those selected for cotton; this tendency is slight, however, as compared to the variation in run-off for the individual plots. For this period, the short plots averaged 33.9-percent run-off, the individual plot run-off ranging from 27.1 percent to 39.1 percent. The medium-length plots averaged 31.9-percent run-off, with individual plot run-off ranging from 23.0 percent to 41.5 percent. The average for the long plots was 28.1-percent run-off, with corresponding individual plot run-off ranging from 19.3 percent to 33.7 percent. These data are shown on graph I. A slight but gradual decline in average run-off percentages accompanies the increasing slope lengths.

Tendencies toward inherent plot variability in run-off are likely to be largely overcome when storm conditions are such as to produce high-intensity run-off, as from excessive rate rainfall or considerable volume. This type of data is of the most interest and importance, since peak run-off rates and associated high erosion losses from cultivated croplands are critical in connection with the design of diversion works as well as control measures in general.

Following the end of the pretest period, three small rains fell on these same plots. Half of the plots had just been bedded for cotton. It happened that the first rain was low in intensity; the second was of moderate rate—between 1 and 2 inches per hour for 5 minutes; and the third was of higher intensity—between 2 and 3 inches per hour for 5 minutes. All three rains totaled but 1.03 inches in volume. Only the oats plots produced run-off.

The run-off data for these nine oats plots for the two more intense of the three rains are shown on graph II.

This graph shows the substantial trend toward consistent relative run-off behavior of individual plots, under the stated conditions, and also shows indication of occasional erratic performance. A given plot may run relatively low in run-off for one rain, but high the next. This has not been true of all plots, nor of the bulk of a set of plots. The erratic run-off suggests variations in topsoil textures and depths as factors in relation to water intake.

It appears likely that with the use of randomized triplicate plots, valid run-off and erosion data will be acquired from these experiments. A 2-year rotation is planned, and the principal interpretations will be on the basis of either the losses associated with excessive storms, or the losses per rotation period.

In summarizing, most of the variation in run-off from these 18 plots has been due to rain characteristics. A slight tendency for the shortest plots to produce the highest percentage of run-off has been consistently noted. Variation between individual plots, or residual variation, is natural and desirable—in fact, unavoidable.

Since a representative spread of soil and erosion conditions such as are found in given fields within a single erosion survey classification, is included in this experiment, it should yield dependable run-off and erosion data.

A Sprinkler System

Clarence F. Olson, of Clayton, Oreg., installed on his farm a sprinkler system for irrigation. The system has provided him with more than a sufficient amount of water.

Mr. Olson financed his sprinkling system last June through the Farm Security Administration. He received technical assistance in working out his farm plan from the Soil Conservation Service.

With an electric motor and a simple pumping unit, water is lifted from the Yamhill River. Six hundred feet of main-line pipe pivots from a 200-foot stationary supply line. Outlets are provided every 60 feet, connecting the 780 feet of lateral line with its 13 hammerhead sprinklers. Each sprinkler throws a 90-foot circle of water. Mr. Olson varies his sprinkler according to the need of his crops and his grass.

Mr. Olson states that formerly 9 or 10 acres of grass were required for the support of 9 cows. Now, between 7 and 8 acres provide all the grass the cows can eat. He plans to increase his livestock, next year, to 12 milk cows and 7 yearlings, and this can be done easily as the grass on his pasture land is now well established.

Wildlife Population Increased

Protecting woodlands from livestock is a standard soil conservation practice, designed to produce better woodlands and conserve soil and moisture. But a recent survey made by biologists of the Soil Conservation Service revealed that woodland protection also greatly affects the wildlife population. These biologists, at Hamilton, Ohio, found that grazed woodlands had 111 pairs of birds per 100 acres. On the other hand, woods which were protected from grazing had 225 pairs of birds per 100 acres—more than twice as many as on the grazed areas.

CONSERVATION PRACTICES IN PRIMITIVE AGRICULTURE

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that had been observed in the locations examined in southern and central Arizona. The terraced areas in many instances were quite small, ranging from 5 to 12 feet up to plots of 8 to 18 feet. In this location again the present water supply is rather deficient for the terraced land. There is some evidence, however, that an early primitive reservoir may have been located about 3 miles distant on the plateau. It was my good fortune to examine this area, and the outlet ditch running down through the wood, in the company of Lancaster of the park staff, who has devoted considerable study to tracing this water system. In places there was a suggestion of old diversion water-detention dams, running off from the faintly outlined ditch which would have carried water along the plateau. At its lower end this ditch would have connected with the present Soda Canyon detention dams and, undoubtedly, would have furnished an adequate supply for corn or other garden crops. I was informed that the largest group of dams known upon the mesa was located some distance away on Wetherill Mesa, and this area would appear to warrant further examination at a later date. The Soda Canyon detention dams and agricultural area would have been readily available from the well-known ruin of Spruce Tree House, from which they are less than a mile distant.

To summarize the foregoing observations, it may be stated that water conservation was clearly the principal purpose of the early cultivators. Soil conservation in many cases was achieved incidentally, since the conservation methods used reduced the run-off and hence slowed down erosion. Throughout the area examined, extremely simple methods were employed. In very few instances was there any regularity or concerted arrangement of the terrace or plot layout. The tract above Pecks Wash near Pima, Ariz., was probably the most comprehensively laid out of any studied. On this area, however, it is doubtful that crops could now be grown, since the erosion control obtained on slopes of 3 to 5 percent was of a temporary nature and there is considerable evidence that slow sheet washing has occurred in the long period of time that has elapsed since use was made of this land by Indian cultivators. At other sites, as at Agua Fria, where the gradient was lower and there was more protective vegetation, examination of the soil profile indicated that crops could probably still be raised, and that the conservation practices had been effective in materially reducing erosion and excessive run-off.

As to present day Indian agriculture, the influence of these ancient practices may be clearly seen in the farming methods of Hopi villages. It is the writer's intention to discuss them in a future article.

WILLOW MATS HALT EROSION

(Continued from p. 127)

posts. Where the stream is large, it may be better to use a large rock-filled woven-wire covered "sausage" jetty, especially at the upstream end of the mat, so that extreme floods will not peel the mat back from banks.

8. Keep livestock out with fence or thorny brush, because livestock destroy willows.

The accompanying sketch depicts step by step the method of construction.

During the first growing season the willow poles send roots into the bank, producing a top growth of 2 to 5 feet. This dense growth develops into permanent protection to the bank, from below the water line to the top of the slope.

Ordinarily the cooperator can furnish all the materials, without any cash outlay except for smooth wire to hold the weights in place and to lace the old woven wire together. These mats are simple to build, and the work makes an excellent labor outlet during the slack winter season.

When the stream is a property line, this type of protection is especially desirable, as it does not change the course of the stream. Within one season after construction, the mat will have developed a dense growth which will hold the soil in place—prevent it from joining the stream in its journey to the sea.

WHEEL CHARTS FOR AGRONOMY

(Continued from p. 119)

degree of erosion studies by regional and area technicians are the bases for both."

The wheel chart must be prepared for each individual area—this because soil types, climatic conditions, and farming practices vary for different areas. The Fennimore chart would not apply to other areas where conditions are not the same. Should they wish to use the device, technicians in other projects will have to prepare charts suitable to their localities.

Similar in appearance to the wheel chart for land-use is a seeding chart devised by Pierre which gives at a glance the rate to seed, the depth to plant, the yield per acre, the time to seed, the soil requirements, and the seed weight per bushel of 43 crops grown in the Fennimore project area. This chart could be easily duplicated in other areas, with a few substitutions for local conditions and crops grown.

From the original rough drafts of the agronomy and land-utilization wheel charts, tracings were made and photographed to secure brown-line duplications. Now, every Fennimore technician has one of the time-saving land-use wheel charts, and every agronomist carries with him in addition, on two sheets of paper, a veritable encyclopedia of seeding information.

BOOK REVIEWS AND ABSTRACTS

by Phoebe O'Neall Faris

LAND DRAINAGE AND RECLAMATION. By Quincy Claude Ayres and Daniels Scoates. New York and London. October 1939.

The first edition of this book came out more than 10 years ago, before many of our special land and water policies and practices were put into effect. Users of the first edition will be very glad to know that the second edition, just off the press, is revised throughout to include a great volume of new material on soil and water conservation aspects of land clearing, drainage, and land reclamation. The information on control of erosion has been expanded from one chapter to three, most of this new material being taken from Mr. Ayres' Soil Erosion and Its Control which was reviewed in the August 1937 issue of SOIL CONSERVATION. As most users of such texts know, Mr. Ayres' treatment of terrace types, design and construction, constitutes today a standard work.

A considerable amount of very recent findings relating to terracing and control of gullies is taken from the works of Soil Conservation Service engineers. For example, a drawing, much used throughout the Service to show the drainage- or channel-type and the absorption- or ridge-type terrace is included in the chapter on terracing, as is also the recommended terrace-spacing table compiled by C. L. Hamilton and published in U. S. D. A. Farmers Bulletin 1789 under his name. Hamilton is quoted more extensively with regard to cost of terrace construction, combination strip crops and terraces, and design for drop-inlet structures.

Mr. Ayres is associate professor in charge of drainage and irrigation engineering at Iowa State College. The second author, Daniels Scoates, is professor of agricultural engineering, A. and M. College of Texas. Their new book is essentially an agricultural engineering text, but in its present form is designed as a workable guide for farmers and farm managers in working out problems on their land.

The introduction has been entirely rewritten to present the engineering features of land reclamation as related to, first, improvement projects, and, second, development projects. As classified by Mr. Ayres and Mr. Scoates, improvement projects are those designed for "reducing unit costs of production and making more productive lands which at present produce some income." Under improvement projects come the following: Farm drainage; control of soil erosion; watering land formerly dry farmed; brush, stump, and stone removal; channel improvement and levee building; drainage of irrigated lands. Development projects, for "bringing into production lands which at present produce no income," include those involving swamp drainage; irrigation; land clearing on large-scale operations; levee and pumping plant construction; reforestation; flood control. An excellent brief history of land drainage is presented in the first chapter, to introduce the discussion of advantages and disadvantages of irrigation and soil-erosion, flood-control, and cut-over land problems today confronting the people of the United States.

The technical text proper begins with chapter 2. About a hundred pages are given over to surveying and mapping, with emphasis on those principles essential to farmers and landowners in laying out land and running boundaries.

Chapters 11 and 12 are devoted to the physical elements (soil and rainfall) having to do with drainage and land reclamation problems, and here is found a careful explanation of the object of the two kinds of drainage—surface and subsurface. Following this is a thorough treatment of open-ditch design, location, construction and maintenance, and of earth dam and levee construction. Much of this part of the text is definitely for the drainage engineer, although the chapter on open-ditch maintenance should be exceedingly useful to the farmer with a surface drainage system on his land.

One looks for the subsurface drainage part of the book to follow immediately after the treatment of open-ditch design and construction; but instead the authors have chosen to include some 200 pages of other discussion and data before treating drainage for the purpose of lowering the water level below the surface of the ground. But once these 200 pages are given careful reading the chapter arrangement seems logical enough, for here is a great mass of up-to-date information relating to practices for the economic use of agricultural land. The purposes of drainage districts and soil conservation districts are first explained as to functions. Useful principles of the law, regarding farm water rights, are discussed for the benefit of the land owner and the agricultural engineer. Directions for the use of explosives in ditching and stump blasting on the farm are given in detail. The methods and practices for clearing cultivable land littered with brush, fallen logs, stumps and second-growth timber are described in detail, from surveying and planning to determine method and cost to the completely cleared field or large area under the plow.

Three chapters, Control of Soil Erosion, Terracing, and Control of Gullies, follow immediately after Land Clearing, and here is the material taken from Mr. Ayres' former book, Soil Erosion and Its Control, with which most agricultural engineers are familiar. Terrace types are defined, directions are given for their design, spacing, grades, length and cross sections, capacity, the surveying procedure and layout, construction; and then terracing equipment is described in detail, and cultivation and maintenance practices are emphasized, especially outlet maintenance.

Subsurface drainage is treated as a six-chapter section near the close of the book. Design of tile drains, selection of tile, installation of tile, and drain-tile accessories for protection of inlets and outlets, are the main subjects treated. Two chapters, Estimating Cost of Tile Drainage, and Special Methods of Drainage, close the volume with the exception of an appendix containing various charts, formulas, and tables for use by drainage engineers.

AMOUNT OF UNDERGROUND PLANT MATERIALS IN DIFFERENT GRASSLAND CLIMATES. By S. H. Shively and J. E. Weaver. University of Nebraska Conservation and Survey Division. Lincoln, Nebr. May 1939.

This new bulletin (No. 21, Nebraska Conservation Division) reports the results of recent studies carried out to determine the correlation between amounts of underground plant materials and aridity increase. Both true and mixed prairie plants were covered in the study; in the former, precipitation decreased by areas from 33 to 26 inches, and in the latter from 23 to 17 inches. Soil groups varied from Prairie to Chermozen and then to Dark Brown and Brown.

The grass samples were taken from nearly pure stands and from numerous mixtures, and included the bluestem, blue grama, buffalo, western wheatgrass, prairie dropseed, slough grass and gama grass. Some of the forbs that have increased enormously during drought periods, as many-flowered aster, daisy fleavane and smooth goldenrod, were studied to determine their relative amounts of underground materials and to compare them with the native grasses. Some 200 samples were collected over a region extending 600 miles in Iowa, Nebraska, Kansas and Colorado.

Exceedingly careful procedures were followed in preparing the samples for examination to determine volume and dry weight of root materials and to correlate these with precipitation and soils. The authors present their data in tabular form, according to the different grasses. Significant findings are pointed out in the text, and some especially fine photographic reproductions are used to illustrate experimental methods and various prairie stands.

During the process of the experiments, soil samples were taken for the determination of organic matter and nitrogen to a depth of 4 inches. The results are presented in table 8, and the authors point out as significant the fact that the average percentage of organic matter decreased from east to west over the region from 7.14 to 2.67. Percent of nitrogen decreased from 0.308 to 0.13. A brief general discussion of these data points out that "climate and soil have a profound effect upon the production of organic matter and total nitrogen in soils both in determining the amount of vegetation, and the extent, nature, and rate and completeness of the decay of the materials produced."

U. S. GOVERNMENT PRINTING OFFICE: 1939

FROM A RECENT ADDRESS BY THE SECRETARY OF AGRICULTURE

"Now what are the American goals worth working for? What are the things we must do to make this, our own land, the Chosen Land?

"We want to see abundance widely shared. What must we do to assure abundance for ourselves and our children and our children's children?

"Our first concern must be the land itself. Our agricultural fertility, our forests, our watersheds, our entire national life are bound up with the welfare of our soil. When the productive soil is ruined, our civilization will be ruined, and our country will revert to desert and wasteland, like the ruined lands of Africa and Asia.

"For many years, we did not realize our danger. Then, with dramatic swiftness, nature brought the lesson home. Five years ago last spring, when millions of tons of powdery soil were lifted by the wind from the thirsty plains and carried across the country and far out over the ocean, nature wrote her warning in the sky. She spread that warning even on the walls in thousands of metropolitan homes.

"Not only with dust, but with water, has nature broadcast her ominous message. Floods in New England, floods in Pennsylvania, floods along the Ohio River, floods here in California—year after year we have been forcibly reminded of the crimes we have been committing against the soil."

—HENRY A. WALLACE.

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Results of selective clearing. The large stump yielded fence posts. Three cuts of oak in the middle background; cordwood at middle left. In the picture above, the clearing is rapidly seeding in. The "after" sequence is seen in the picture below, which shows woods improvement well under way. Farm forestry as a part of the better land use program is discussed in Dr. Bennett's article beginning on the opposite page.